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MASSACHUSETTS

INSTITUTE OF TECHNOLOGY.

ANNUAL REPORT

OF THE

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DECEMBER 12, 1894.

JOHN WILSON AND SON.
University Press, Cambridge.
1894.

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TO THE CORPORATION OF THE MASSACHUSETTS INSTITUTE OF TECHNOLOGY:

THE year upon which I now have the honor to report has, on the whole, been one of prosperity. In May, the largest class in the history of the School was graduated; in September, the Institute opened with the largest number of students ever upon its register. The courses of instruction have been still further diversified and improved; and considerable additions have been made to the apparatus of instruction. We have been fortunate in everything except in the matter of our finances, and of the severe losses which the Corporation has suffered through the decease of three valued members.

The number of students, this year, is 1,183, as against a registration of 1,157, last year. This is not a little remarkable, since several causes have been operating which appeared to threaten a very considerable falling off in our numbers. The first of these was found in the hard times, which continued until after the opening of the school year, seriously affecting the incomes of all classes in the community. The influence of such a cause is especially felt in the Institute of Technology, since an unusually large proportion of our students come from families of moderate means; and no small part of our constituency consists of those who would never even consider the possibility of going first to a classical college and then to a professional school. Indeed, so serious has been the pressure of the times that a number of students who had gone so far as to register at the opening of the school, were obliged to withdraw, upon finding that they could not make the financial arrangements to enable them to stay.

The second cause which contributed to check the normal rate of increase at the Institute, this year, is found in the advanced requirements in mathematics, by which applicants were, for the first time, obliged to present either Advanced

Algebra or Solid Geometry. Some of the schools, as well as some young men fitting themselves for the Institute by their own exertions, were unable to meet this requirement on such brief notice; and the effect was to throw not a few back into the entering class of 1895. The range of this effect is illustrated in the fact that the number of persons taking the preliminary examinations in June last, with reference to entrance next year, was just fifty per cent greater than in June, 1893.

The third cause which might have been looked to for producing a falling off in the attendance at the Institute was to be found in the rapid increase of schools, not only in the immediate vicinity of Boston, but in every part of the country from which we draw our students, which are offering courses of instruction more or less like those given here. That increase is indeed remarkable. It has been stated that not less than one hundred colleges and universities in the United States are to-day offering technical instruction. There is now not a State in the Union without an institution in which more or less of a course in Engineering is laid out. Some of these are classical institutions of long standing and high repute, which are as rapidly as possible transforming themselves to meet the wants of the age. If, indeed, "imitation is the sincerest flattery," those who originated the earlier schools of science and technology have reason to pray that their heads may not be turned, as one classical college after another throws overboard studies and exercises which thirty years ago were declared to be absolutely essential to mental discipline and culture, without which no one could become a thoroughly educated and cultivated man, to make room for studies and exercises which, even down to recent days, have been stigmatized as interested, mercenary, and of a base flavor. Certainly the surviving founders of the Massachusetts Institute of Technology, who, from 1857 to 1865, supported President Rogers and Dr. Jacob Bigelow in the demand for an educational system better adapted to the wants of modern life than the mediæval and monastic culture

then alone offered to the aspiring student, have reason to rejoice that the battle of the New Education is won.

It is not infrequently the fate of those who have led in reforms to be sacrificed to the very greatness of the success achieved, to be buried under the mighty pile whose foundations they laid deep under ground. It is, indeed, a law of social life at which we may not repine, that the laborer of the eleventh hour often reaps an equal reward with those who have borne the burden and heat of the day; and we might, therefore, not unnaturally have looked to see, in the general, the almost universal, adoption of the methods of laboratory instruction and practice first developed here at the Institute of Technology, the beginning of a decline in the relative importance and influence of this school. But such a result I, for one, do not anticipate or fear. The greater and the more widely spread the desire for scientific education, the greater, I believe, will be the need of an institution which is prepared to lead in the development of such instruction; the larger will be the constituency to which the Institute of Technology will appeal; the more numerous will be the young men who, having made up their minds to seek such instruction, will determine to get it in its highest and best form. While the institutions which are so rapidly taking up the methods of scientific and technical instruction do well thus to answer the demands of the age, they cannot hope at the beginning to afford their students all, or nearly all, the advantages and facilities which in the older schools of science and technology have been the accumulation of many years, or are the fruit of careful study and long experience. Much of this can be transplanted; much of it cannot. Scientific and technical schools can no more be improvised than can universities and schools of classical culture. More than one first crop must be "ploughed under," in experiments upon the adaptation of the soil and the climate to the seed sown. Even when a moderate degree of success has been attained, it still remains for time and experience to perfect the system. There has been no year during the whole life of the Institute of

Technology when its own work has not been, in an appreciable measure, better done than in the year immediately preceding. Only through continuous experience, closely studied and interpreted; only through adaptations almost insensibly accomplished; only through consultation and comparison of results carried on year after year, — can the highest results in this department of effort be obtained. Take our department of Architecture, for example. I do not hesitate to say that no school in the United States, beginning at the present time, though in the possession of unlimited means, could in five years work itself up to the point of giving such instruction as we are giving to-day; and by the end of those five years, the Institute of Technology, granted only fair fortune, will be far ahead of its present position.

For these reasons I have no fear of any decline in the relative importance or influence of our school. There will be as much need of leadership in this department of education as ever, even as in the early days when the Faculty of the Institute of Technology first developed the laboratory of General Chemistry, the laboratory of General Physics, the laboratory of Economic Metallurgy, the laboratory of Applied Mechanics, and the laboratories of Steam, Hydraulic, and Electrical Engineering. And the more highly the educational value of scientific study and practice is appreciated, the whole land over, the larger, and not the smaller, will be the number of those who will desire to obtain that instruction and training under the very best conditions.

The Graduating Class.

The school year of 1893–94 closed fortunately, on the 29th of May. Of the 137 members of the class, 21 graduated in Civil Engineering, 31 in Mechanical Engineering, 4 in Mining Engineering, 13 in Architecture, 11 in Chemistry, 33 in Electrical Engineering, 1 in Biology, 3 in Physics, 12 in Chemical Engineering, 3 in Sanitary Engineering, while 5 graduated from the department of General Studies.

The Entering Class.

The registration of this year, as by the catalogue now in press, amounts to 1,183 against 1,157 twelve months ago, a gain of 26. The following table exhibits the number of students in the school each year, from the opening of the Institute to the present time: —

Year.	No. of Students.	Year.	No. of Students.
1865–66	72	1880–81	253
1866–67	137	1881–82	302
1867–68	167	1882–83	368
1868–69	172	1883–84	443
1869–70	206	1884–85	579
1870–71	224	1885–86	609
1871–72	261	1886–87	637
1872–73	348	1887–88	720
1873–74	276	1888–89	827
1874–75	248	1889–90	909
1875–76	255	1890–91	937
1876–77	215	1891–92	1,011
1877–78	194	1892–93	1,060
1878–79	188	1893–94	1,157
1879–80	203	1894–95	1,183

Students by Classes.

The aggregate number of students for 1894–95 is divided among the several classes as follows: —

Graduate students, candidates for advanced degrees	5
Regular students, Fourth Year	153
" " Third "	186
" " Second "	215
" " First "	276
Special students	348
Total	1,183

Comparison with the corresponding figures of last year shows that there has been an increase of 3 among the graduate students, candidates for advanced degrees; among the regular students in the fourth year of 7; in the third year of

28; in the second year of 8; and among the special students of 14. There has been a decrease of 34 in the regular students of the first year.

Assigning the special students to classes, according to the predominant studies pursued by them, we reach the following division of the whole body among the several years: —

Class.	Regular.	Special.	Total.
Graduates of the M. I. T., candidates for advanced degrees	5		5
Fourth Year	153	49	202
Third Year	186	111	297
Second Year	215	144	359
First Year	276	44	320
Total	835	348	1,183

Statistics of Examinations.

Of the 1,183 students of the present year, 415 were not connected with the school in 1893–94; 14 had been connected with the Institute at some previous time, and returned to resume their places in the school; 42 were admitted provisionally without examination; 29 were admitted by examination as special students; 71 were admitted on the presentation of diplomas or certificates from other institutions of college grade.

Excluding from consideration those who were admitted, but have not in fact entered the school, 61 in number, the following was the final result of the examinations held in June and September: —

Admitted clear	190	
" on one condition	40	
" on two conditions	22	
" on more than two conditions	7	
		259
Rejected		28
		287

The statistics show this to have been the best examination ever held.

Examination at Distant Points.

In addition to the entrance examinations held at Boston in June and September, examinations were also conducted in June at Belmont (Cal.), Buffalo, Chicago, Cincinnati, Cleveland, Colorado Springs, Denver, Des Moines, Detroit, Easthampton (Mass.), Exeter (N. H.), Louisville, New York, Philadelphia, Pittsburgh, Poughkeepsie, St. Paul, and Washington.

Residence of Students.

Thirty-seven States of the Union, besides the District of Columbia and the Territories of Utah and New Mexico, are represented on our list of students. Of the total number of

States.	Candidates for Advanced Degrees.	Fourth Year.	Third Year.	Second Year.	First Year.	All Regular Students.	Special Students.	Total.
Alabama	..	..	1	..	..	1	..	1
California	..	3	2	..	2	7	2	9
Colorado	..	2	..	1	2	5	3	8
Connecticut	..	4	4	9	6	23	6	29
Delaware	1	..	1	2	..	3	..	3
Dist. of Columbia	..	..	2	2	6	10	2	12
Florida	..	..	1	..	..	1	1	2
Georgia	..	..	..	..	..	..	2	2
Illinois	..	3	11	8	6	28	8	36
Indiana	..	1	..	..	1	2	1	3
Iowa	..	4	1	..	1	6	4	10
Kansas	..	..	..	..	4	4	..	4
Kentucky	..	1	..	4	4	9	3	12
Louisiana	..	1	1	..	..	2	1	3
Maine	..	5	7	5	11	28	10	38
Maryland	..	1	1	..	..	2	2	4
Massachusetts	1	91	107	134	179	511	196	707
Michigan	..	1	1	..	1	3	5	8
Minnesota	1	1	1	3	1	6	3	9
Missouri	..	1	2	3	3	9	5	14
Montana	..	..	..	1	..	1	1	2
Nebraska	..	2	1	..	1	4	..	4
Nevada	..	1	..	..	..	1	1	2
New Hampshire	1	5	8	4	6	23	4	27
New Jersey	..	..	..	..	3	3	2	5
New Mexico	..	..	1	..	..	1	..	1
New York	..	3	12	11	14	40	19	59
Ohio	..	7	6	6	7	26	24	50
Oregon	..	..	..	1	..	1	..	1
Pennsylvania	..	6	4	7	8	25	12	37
Rhode Island	1	6	3	7	4	20	5	25
South Carolina	..	..	1	..	1	2	1	3
Tennessee	..	..	..	..	..	..	1	1
Texas	..	..	3	..	1	4	2	6
Utah	..	..	..	..	..	..	2	2
Vermont	..	..	..	1	1	2	1	3
Virginia	..	..	..	..	..	..	2	2
Washington	..	..	..	..	..	..	3	3
West Virginia	..	..	..	..	..	..	1	1
Wisconsin	..	..	2	2	..	4	2	6
Foreign Countries.								
Belgium	..	..	1	..	..	1	..	1
Brazil	..	..	..	..	1	1	..	1
Chile	..	..	..	..	..	..	1	1
Cuba	..	..	..	..	..	..	1	1
Germany	..	..	1	..	..	1	..	1
Holland	..	2	..	..	..	2	..	2
Ireland	..	1	..	..	..	1	..	1
Japan	..	..	..	1	..	1	..	1
Mexico	..	..	..	..	..	..	1	1
New Brunswick	..	1	..	..	..	1	..	1
New So. Wales	..	..	..	..	..	..	1	1
Nova Scotia	..	..	..	..	..	..	1	1
Ontario	..	..	..	2	..	2	2	4
Porto Rico	..	..	..	..	1	1	..	1
Quebec	..	..	..	1	1	2	..	2
Scotland	..	..	..	..	..	..	1	1
Spain	..	..	..	..	..	..	1	1
Turkey	..	..	..	..	..	..	1	1
Venezuela	..	..	..	..	..	..	1	1
Total	5	153	186	215	276	835	348	1183

1,183, 707 are from Massachusetts, or 59.8 per cent of the whole; 122 are from other New England States; 354 are from outside New England. Of these, 24 are from foreign countries.

A table showing the number of students in each year from and including 1888, coming from each State or Territory and from each foreign country, may not be without interest and instruction: —

	1888.	1889.	1890.	1891.	1892.	1893.	1894.		1888.	1889.	1890.	1891.	1892.	1893.	1894.
States.								*States.*							
Alabama	..	1	..	2	4	2	1	Washington	..	2	2	3	3	1	3
Arkansas	2	2	3	3	2	1	..	West Virginia	..	2	2	2	2	1	1
California	13	10	14	19	14	15	9	Wisconsin	7	9	10	7	5	11	6
Colorado	2	6	4	7	7	5	8	Wyoming	1	..	..	..	..	..	..
Connecticut	28	36	31	30	27	30	29								
Delaware	..	..	1	..	2	4	3	*Foreign Countries.*							
Dist. of Columbia	9	9	7	4	4	7	12								
Florida	..	2	3	3	4	3	2								
Georgia	1	1	2	2	3	3	2	Argentine Rep.	..	..	2	..	..	..	..
Idaho	..	..	..	1	1	1	..	Belgium	..	..	..	..	1	1	1
Illinois	37	33	34	32	40	39	36	Brazil	2	2	2	4	..	..	1
Indiana	1	3	6	2	5	6	3	Bulgaria	..	1	1	1	1	1	..
Iowa	6	4	9	10	10	13	10	Central America	..	..	..	1	1	1	..
Kansas	..	..	2	2	1	1	4	Chile	..	..	..	..	..	..	1
Kentucky	3	4	4	8	7	11	12	Colombia	..	1	..	2	..	..	..
Louisiana	2	4	8	5	2	3	3	Cuba	..	..	..	..	..	1	1
Maine	26	30	29	27	39	36	38	England	..	..	2	1	1	1	..
Maryland	4	4	7	7	6	4	4	France	..	1	1	1	1	1	..
Massachusetts	494	533	517	565	603	665	707	Germany	..	..	..	..	..	2	1
Michigan	12	13	16	13	10	7	8	Greece	1	..	..	..	..	..	..
Minnesota	8	10	12	13	13	11	9	Guatemala	1	1	..	..	1	..	..
Missouri	7	8	8	12	13	17	14	Hawaiian Islands	1	1	4	4	2	2	..
Montana	..	..	1	..	..	2	2	Holland	..	..	..	2	2	2	2
Nebraska	2	1	1	1	4	3	4	Ireland	1	1	1	..	..	1	1
Nevada	..	..	1	3	3	2	2	Japan	..	1	4	3	1	1	1
New Hampshire	24	21	23	24	29	32	27	Mexico	..	1	1	1	1	1	1
New Jersey	8	13	11	16	11	6	5	New Brunswick	1	1	1	2	1	1	1
New Mexico	2	..	..	1	2	2	1	New South Wales	..	..	..	1	1	1	1
New York	31	25	40	40	50	52	59	Nova Scotia	..	2	2	1	..	..	1
North Carolina	1	2	1	1	1	..	..	Ontario	2	1	1	2	2	4	4
Ohio	23	35	33	33	39	45	50	Peru	2	1	3	1	..	..	..
Oregon	1	2	1	1	2	1	1	Porto Rico	2	2	2	1	..	1	1
Pennsylvania	18	23	22	26	25	31	37	Quebec	1	1	4	4	5	5	2
Rhode Island	22	22	21	26	24	33	25	Scotland	1	1	3	2	1	2	1
South Carolina	..	1	2	4	1	3	3	Spain	..	..	..	..	1	1	1
South Dakota	1	1	..	..	..	..	..	Trinidad	1	1	1	1	..	..	..
Tennessee	3	5	3	4	1	1	1	Turkey	1	2	1	2	1	..	1
Texas	2	..	1	2	5	6	6	Venezuela	..	..	..	1	..	1	1
Utah	..	..	..	..	1	2	2								
Vermont	5	4	4	5	4	5	3	Total	827	905	937	1,011	1,066	1,157	1,183
Virginia	4	6	5	6	4	3	2								

Residence of Massachusetts Students.

It has been said that 59.8 per cent of our students are from Massachusetts. All the counties of the State, except the

small counties of Dukes and Nantucket, send students to the Institute. One hundred and twenty-four cities and towns are borne on the lists, nine more than last year. The first column of the following table shows the number of cities and towns in each county sending pupils to the Institute; the second column gives the aggregate number from each county. It appears that Suffolk sends 215 and Middlesex 201 pupils; Essex comes third, with 87; Norfolk fourth, with 74.

County.	No. of Towns.	No. of Students.	County.	No. of Towns	No of Students.
Barnstable . .	7	9	Hampshire . . .	4	4
Berkshire . . .	5	14	Middlesex . . .	29	201
Bristol	7	27	Norfolk	17	74
Essex	19	87	Plymouth . . .	12	33
Franklin . . .	4	4	Suffolk	4	215
Hampden . . .	5	16	Worcester . . .	11	23
Total . . .	47	157	Total	124	707

The following is a list of the towns, thirty-eight in number, which send four or more students to the Institute: —

Boston . . .	202	Springfield .	9	Medford . .	6
Newton . .	34	Framingham .	8	Reading . .	6
Cambridge .	28	Lawrence . .	8	Salem . . .	6
Brookline . .	26	Plymouth . .	8	Arlington . .	5
Newburyport	22	Watertown .	8	Gloucester .	5
Hyde Park .	17	Brockton . .	7	Quincy . . .	5
Lynn . . .	17	Fitchburg . .	7	Wakefield .	5
Somerville .	17	Melrose . .	7	Belmont . .	4
Lowell . . .	15	Natick . . .	7	Foxboro' . .	4
Chelsea . .	11	Pittsfield . .	7	Lincoln . .	4
Waltham . .	11	Taunton . .	7	Weymouth .	4
New Bedford	10	Concord . .	6	Woburn . .	4
Malden . .	9	Haverhill . .	6		

It may be interesting to note the number of students coming to us from the chief cities of the United States, distant or near, outside Massachusetts, — Albany, 1; Atlanta, 2; Baltimore, 1; Bangor, 6; Brooklyn, 11; Buffalo, 9; Charleston, 2;

Chicago, 21; Cincinnati, 13; Cleveland, 7; Columbus, Ohio, 1; Dayton, 6; Denver, 3; Des Moines, 3; Detroit, 7; Evanston, Ill., 5; Exeter, 2; Hartford, 6; Indianapolis, 2; Louisville, 6; Manchester, N. H., 2; Milwaukee, 2; Minneapolis, 4; Montreal, 2; Nashville, 1; New Haven, 1; New Orleans, 1; New York, 16; Norwich, 5; Omaha, 3; Pawtucket, 3; Philadelphia, 8; Pittsburgh, 7; Portland, Me., 17; Portsmouth, N. H., 5; Poughkeepsie, 3; Providence, 18; Rochester, 2; St. Louis, 11; St. Paul, 5; San Francisco, 6; Toledo, 4; Troy, 2; Utica, 4; Washington, D. C., 12; Wilmington, Del., 4.

The following table exhibits for ten years the distribution of the total number of students among two classes: first, those students whose names are found upon the Catalogue of the year preceding; and secondly, those whose names appear upon the Catalogue of the year to which the statement relates.

Year.	(1) Total No. of Students.	(2) No. of Students in the Catalogue of the previous year who remain in the Institute.	(3) No. of New Students entering before issue of Catalogue.	(4) Of those in column (3) the following number are regular first-year Students.	(5) No. of New Students not of the regular first-year class
1885–86	609	369	240	177	63
1886–87	637	379	258	190	68
1887–88	720	396	324	229	95
1888–89	827	465	362	245	117
1889–90	909	557	352	255	97
1890–91	937	572	365	234	131
1891–92	1,011	624	387	258	129
1892–93	1,060	618	442	303	139
1893–94	1,157	701	456	301	155
1894–95	1,183	768	415	271*	144

It appears from the foregoing that the number of students remaining over from last year to this has been increased by sixty-seven, while the number registered for the first time is smaller by forty-one, making the net increase, as stated, twenty-six.

* In addition five students are repeating the first year.

Ages of Students on Entrance.

The next table exhibits the ages of our students upon entrance, after taking out those who are repeating the first year, and nine of unusual ages. These deductions leave two hundred and seventy as the number of students whose ages have been made the subject of computation. The results appear in the following table, in comparison with the corresponding results of 1893–94.

Period of Life.	1893–94.		1894–95.	
	Half-year Groups.	Yearly Groups.	Half-year Groups.	Yearly Groups.
16 to 16½ years	1	–	2	–
16½ to 17 "	2	3	10	12
17 to 17½ "	23	–	20	–
17½ to 18 "	56	79	27	47
18 to 18½ "	48	–	45	–
18½ to 19 "	47	95	67	112
19 to 19½ "	51	–	37	–
19½ to 20 "	30	81	23	60
20 to 20½ "	9	–	16	–
20½ to 21 "	9	18	5	21
21 to 22 "	8	8	18	18
	284	284	270	270

From the foregoing, it appears that the average age on entrance is the same as last year; namely, eighteen years and nine months.

In this connection I present the ages, at graduation, of the class leaving us in May. The one hundred and thirty-seven members of the class were distributed among the different periods of life as follows: —

Between 20 and 20½	3
" 20½ " 21	6
" 21 " 21½	18
" 21½ " 22	16
" 22 " 23	46
" 23 " 24	27
24 and over	21
Total	137

It is significant of the character of a large class of our "special students" that of the three hundred and forty-eight, sixty-four are twenty-five years of age, or over.

In this immediate connection I desire to refer to statements recently made regarding the preparation of students entering this and other scientific and technical schools. At the October meeting of the New England Association of Colleges and Preparatory Schools, President Eliot, Chairman of "The Committee of Ten," spoke as follows: —

"It is the plain fact that the scientific and technological schools of this country — I have in mind no particular school, and my remark would apply just as well to the Lawrence Scientific School, or to the Sheffield Scientific School, as to the Institute of Technology — have admitted young men by hundreds who have never accomplished anything like the course of instruction provided in any one of the programmes recommended by the Committee of Ten. The committee, I am sure, would unanimously desire that the scientific and technological schools should raise their requirements for admission until these schools should give a real support to secondary education. At present they are eating into the secondary schools. They receive secondary-school pupils one year, and even two years, before they have finished a fair secondary-school course."

I am not confident that I gather the exact purport of these words. President Eliot may not have intended to intimate that students entering scientific and technological schools are, in point of preparation, far behind those entering classical colleges; but it was thus I understood his words on hearing them, at the time; and it is with that meaning they have generally been received and commented on. This certainly is the significance which a casual reader of the official report of the proceedings would be likely to give them. From such an opinion I should be compelled to express my dissent very strenuously.

It is unquestionably true that the range of studies upon which this and other scientific and technical schools conduct

entrance examinations is smaller than that upon which examinations are held for admission to classical colleges, in general; but it does not follow from this, alone, that the virtual amount of preparation, the real training given to the powers of the pupil, and his actual capability for doing good work, are less in the one case than in the other. At the Institute of Technology students enter at the average age of eighteen years and nine or ten months; indeed, if instances of exceptional ages had not been excluded from the comparison, the average, this year, would have been raised to nineteen years. This is fully equal to the age at which students enter the great majority of classical colleges in this country. It is higher than at many colleges. It only lacks two or three months of reaching the point at which students enter Harvard, whose requirements have long been known to be beyond those of any other classical college. Nor is there any reason, so far as I am advised, for supposing, in respect to the large majority of pupils entering scientific and technical schools, that they did not begin study as early in life, and keep it up as long and as constantly, as did the pupils entering the classical colleges. If, now, the age of entrance is substantially the same at the scientific schools and at the colleges, and if the pupils entering must be presumed to have been on substantially the same terms as to the amount of attendance at school up to that age, it would seem not unfair to draw the conclusion that our students have had substantially the same amount of mental training and discipline, though they may not have prepared themselves for examination upon as wide a range of subjects. If they did not study as many things as those who were fitting themselves for classical colleges, may they not have fitted themselves better on the narrower line of subjects? If they have not been as much crammed, may they not have been as well trained? If they have been at school as long, why should we suppose that they have not done as much studying? And if they have done as much studying, why should we assume that they have derived any less advantage from it? I do not see how, in the face of such

statistics as those given on page 15, one can escape the conclusion that students on coming here have substantially the same amount of actual, virtual, mental preparation as students entering college, unless he is prepared to make one or both of two assumptions; namely, that the men going to scientific and technical schools are possessed of less native capability, or that they are less industrious and faithful students. I trust there is no champion of the so-called liberal studies who would show himself so illiberal as to venture to make either of the foregoing assumptions.

It is unquestionably true that pupils sometimes "cut across lots" from the fitting schools to the schools of science and technology, just as they do from the fitting schools to most of the classical colleges. There is no way, which would not amount to absolute tyranny, by which this can be prevented; indeed, it is not always a thing which one would desire to prevent. Instances will occur where a young man who is pressed for time or means may well resort to such a course. The valedictorian of my class in college entered from no school at all, to speak of, with probably a smaller amount of preparation than any other member; and the present year it has come to my knowledge that a young man, who had become dissatisfied with his progress in preparation for college, made up certain of his studies outside the school, and, on offering himself, a year in advance, at one of our most distinguished universities, passed the best examination of all the applicants for admission. This "cutting across lots" is a thing which it is impossible in instances to prevent, and, in my judgment, undesirable to attempt to prevent. In general, I do not believe that a comparison, fairly made, between students of scientific and technical schools and students of colleges, as to the amount of actual preparation respectively received by them, would result to the disadvantage of the former class.

Proportion of Regular and of Special Students.

The following table exhibits both the absolute number of regular and of special students, as by the Catalogue of each successive year since 1882, and the proportion existing between these two classes: —

Year.	No. of Regular Students.	No. of Special Students.	Total No. of Students.	Percentage.	
				Regular.	Special.
1882–83	219	149	368	60	40
1883–84	272	171	443	61	39
1884–85	368	211	579	64	36
1885–86	415	194	609	68	32
1886–87	442	195	637	69	31
1887–88	520	200	720	72	28
1888–89	590	237	827	71	29
1889–90	652	257	909	72	28
1890–91	658	279	937	70	30
1891–92	706	305	1,011	70	30
1892–93	774	286	1,060	73	27
1893–94	823	334	1,157	71	29
1894–95	835	348	1,183	71	29

Women as Students at the Institute.

The number of women pursuing courses with us is fifty-eight, as against forty-six last year. Of these, five are graduates of colleges. Of the total number, one is a regular student of the fourth year; three of the third year; five of the first year. Forty-nine are special students. Of the four regular students of the upper classes, three take Course IV., Architecture; one, Course XII., Geology. Of the special students, four devote themselves to Chemistry; three to Physics; thirty-one chiefly to Biology and allied subjects; five to Geology; one to Architecture; two to English, History, or Political Science; three to first-year subjects.

Graduates of Other Colleges.

The number of students who are graduates from this and other institutions is seventy-two. Of these, ten are our own graduates, of whom five are pursuing studies as candidates for advanced degrees; sixty-three are graduates of other institutions, pursuing courses of study with us, either as regular or as special students. Twenty-two are graduates of Harvard University; three, each, of Yale University, Williams and Smith Colleges; two, each, of Johns Hopkins and Brown Universities, Dartmouth College, the Sheffield Scientific School of Yale University, and the United States Military Academy at West Point: while the following institutions, universities or colleges, are represented on our list by a single graduate each, — Trinity College, (Dublin), University of Göttingen, Charleston College, University of Chicago, Havana, Iowa State Agricultural College, Iowa State University, Northwestern University, Centre, Lafayette, Oberlin, Wellesley, Universities of Minnesota, Western of Pennsylvania, Venezuela, California, Santiago, Oregon, Louisiana, Columbian; New Hampshire College of Agriculture & Mechanic Arts; Mt. St. Mary's, Hahnemann, Amherst, National Deaf Mute College.

The candidates for advanced degrees are Messrs. J. A. Meyer, Jr., of the class of '91, in Architecture; Messrs. C. G. Abbot, H. B. du Pont, F. M. Mann, and W. O. Scott, of the class of '94, in Physics, Chemical Engineering, Architecture, and Chemistry, respectively. Mr. A. E. Leach, of the class of '86, in Chemical Engineering, and Mr. C. R. Boss, of the class of '94, in General Studies, are now taking special work in Chemistry; Prof. Walter Barrows, of the Michigan State Agricultural College, and a graduate of the Institute in '74, is spending a part of his winter vacation in biological work in the laboratories of the Institute. Of the sixty-seven not candidates for advanced degrees, thirty are regular students, — namely, fourteen in the fourth year; fourteen in the third

year; two in the second year: the remaining thirty-seven are special students. Of the thirty graduates who are regular students in the three upper classes, eight take Civil Engineering; one, Mining Engineering; one, Mechanical Engineering; seven, Architecture; two, Chemistry; nine, Electrical Engineering; one, Naval Architecture; one, both Electrical and Chemical Engineering.

The Courses of Instruction.

The following table presents the numbers of the regular students in the second, third, and fourth years, by courses.

Year.	Civil Engineering.	Mechanical Engineering.	Mining Engineering and Metallurgy.	Architecture.	Chemistry.	Electrical Engineering.	Biology.	Physics.	General Course.	Chemical Engineering.	Sanitary Engineering.	Geology.	Naval Architecture.	Total.
4th Year Class	26	36	3	13	13	36	..	2	4	11	4	2	5	155*
3d " "	31	27	8	16	16	58	2	4	7	7	4	..	6	186
2d " "	31	48	8	19	21	43	3	3	8	17	5	..	9	215
Total . . .	88	111	19	48	50	137	5	9	19	35	13	2	20	556*

The following table shows the figures of the total line in the foregoing table, in comparison with the corresponding figures for the next nine preceding years: —

* Counted twice, two.

Year.	Civil Engineering.	Mechanical Engineering.	Mining Engineering and Metallurgy.	Architecture.	Chemistry.	Electrical Engineering.	Biology.	Physics.	General Course.	Chemical Engineering.	Sanitary Engineering.	Geology.	Naval Architecture.	Total.
1885 . . .	44	74	26	10	23	41	4	1	5	..	..	..	..	228
1886 . . .	45	75	19	13	24	52	4	2	8	..	..	..	..	242
1887 . . .	50	89	16	18	23	61	5	6	14	..	..	..	..	282
1888 . . .	71	100	12	21	28	74	4	5	12	11	..	..	..	338
1889 . . .	79	99	14	30	29	91	9	5	12	14	6	..	..	388
1890 . . .	79	95	18	27	27	105	11	4	13	18	7	3	..	407
1891 . . .	81	104	17	33	23	108	11	5	19	28	9	3	..	441
1892 . . .	76	106	19	37	35	112	9	5	16	34	5	3	..	457
1893 . . .	78	97	22	50	39	141	4	10	19	31	10	2	8	511
1894 . . .	88	111	19	48	50	137	5	9	19	35	13	2	20	556*

It will appear from the foregoing table that the course in Electrical Engineering remains the largest of the courses of the school. The courses in Mechanical and Civil Engineering follow in the order in which I name them. These three courses together embrace three hundred and thirty-six of the five hundred and fifty-four regular students, candidates for the degree, in the three upper classes. In the case of Course IV., Architecture, the number of regular students fails to measure the importance of the department to the school, inasmuch as that course embraces a considerable number of college graduates and of young men who have had experience as draughtsmen and assistants in architects' offices, who are allowed to enter the department as special students, to get as nearly as possible what they require without passing through the full course. Thus, the number of special students in Architecture in the three upper classes, the present year, is sixty-one, which, added to the forty-eight regular students, makes the total number one hundred and nine. The Chemical and Biological courses also contain considerable numbers of special students, often of advanced grade, some of them teachers or persons who have been engaged in professional practice.

* Counted twice, two.

The following table exhibits the number of persons who have graduated within each of the several courses at each succeeding year since the first diplomas were conferred: —

Year.	Civil Engineering.	Mechanical Engineering.	Mining Engineering.	Architecture.	Chemistry.	Metallurgy.	Electrical Engineering.	Natural History or Biology.	Physics.	General Course.	Chemical Engineering.	Sanitary Engineering.	Geology	Total.
1868	6	1	6	..	..	..	..	..	..	1	..	..	..	14
1869	2	2	..	..	1	..	..	..	..	..	..	..	..	5
1870	4	2	2	..	1	..	..	..	..	1	..	..	..	10
1871	8	2	5	..	2	..	..	..	..	..	..	..	..	17
1872	3	1	5	..	3	..	..	..	..	..	..	..	..	12
1873	12	2	3	1	7	..	..	..	..	1	..	..	..	26
1874	10	4	1	1	..	..	..	..	..	2	..	..	..	18
1875	10	6	6	1	1	..	..	..	1	2	..	..	..	27
1876	12	9	7	..	5	1	..	2	3	4	..	..	..	43
1877	12	6	8	4	2	..	..	..	..	..	..	..	..	32
1878	8	2	2	3	3	..	..	..	..	1	..	..	..	19
1879	6	8	3	1	3	..	..	1	1	..	..	..	..	23
1880	3	..	3	..	1	..	..	..	..	1	..	..	..	8
1881	3	5	6	3	8	..	..	1	..	2	..	..	..	28
1882	2	5	5	3	6	..	..	1	1	1	..	..	..	24
1883	3	7	5	1	3	..	..	..	..	..	..	..	..	19
1884	5	6	13	..	12	..	..	..	..	..	..	..	..	36
1885	4	6	8	2	4	..	2	..	..	1	..	..	..	27
1886	9	23	7	1	7	..	10	1	..	1	..	..	..	59
1887	10	17	8	1	9	..	8	1	1	3	..	..	..	58
1888	11	25	4	5	10	..	17	3	1	1	..	..	..	77
1889	15	23	5	3	8	..	17	1	1	2	..	..	..	75
1890	25	27	3	5	13	..	18	3	2	6	..	..	..	102
1891	17	26	4	6	11	..	23	3	3	1	7	..	1	102
1892	22	26	4	13	7	..	36	6	1	7	4	6	1	133
1893	25	30	5	2	8	..	41	2	..	6	8	..	2	129
1894	21	31	4	13	11	..	33	1	3	5	12	3	..	137
Total	268	302	132	69	146	1	205	26	18	49	31	9	4	1,260
Deduct names counted twice														8
Net total														1,252

The following table shows, by classes and by courses, the number of regular students who have registered themselves as electing to distribute the required studies and exercises over the period of five years.

Year	Total.	Course.												Course Undetermined.
		I.	II.	III.	IV.	V.	VI.	VII.	IX.	X.	XI.	XII.	XIII.	
First	4	..	..	..	..	1	..	..	1	..	..	..	..	2
Second	11	1	3	1	..	..	3	..	2	..	..	..	1	..
Third	12	..	1	1	2	..	5	1	1	..	..	..	1	..
Fourth	6	..	3	..	..	..	1	..	..	..	..	2	..	..
Fifth	12	2	3	..	3	..	2	..	..	1	1	..	..	..
	45	3	10	2	5	1	11	1	4	1	1	2	2	2

Classification of Special Students.

Our special students can, of course, not be classified systematically; but the following table exhibits the number of such students pursuing each particular branch of study: —

Applied Mechanics	66	Language	180
Architecture	61	Mathematics	194
Biology	31	Mechanical Engineering	76
Chemistry	146	Mining Engineering	18
Civil Engineering	38	Naval Architecture	3
Drawing	165	Physics	178
Electrical Engineering	28	Political Science	61
English	109	Shopwork	56
Geology	55	Sanitary Chemistry	2
History	79		

The following is the number of students, either regular or special, pursuing certain leading branches of study, in each of the four years, as follows: —

	First Year.	Second Year.	Third Year.	Fourth Year.	Total.
Mathematics	319	292	196	48	855
Chemistry	363	89	69	49	570
English	302	264	11	9	586
French	196	88	36	17	337
Physics	..	309	264	87	660
German	79	219	163	2	463
Shopwork	9	123	37	53	222

In my last report I mentioned the agreement, sanctioned by the Executive Committee of the Corporation, by which the classes of the Boston Normal School of Gymnastics, supported by Mrs. Mary Hemenway, were to receive their instruction in Chemistry, Physics, and Biology at the Institute of Technology, but without being registered as students of the Institute. That arrangement, which had been entered upon at the date of my last report, was carried through with satisfaction to the officers of the Normal School of Gymnastics and to the Faculty of the Institute. The pupils thus brought to us were found to be of exceptional capacity, of great zeal in the pursuit of knowledge, and strictly attentive to our rules and requirements. The number thus receiving tuition was fifty. The eminent and large-hearted philanthropist to whose benefactions the school owes its foundation and endowment, having died during the year, the executors of her will have, in carrying out her expressed purpose, continued the arrangement for the current year. The classes now receiving tuition number sixty-four, including eight advanced students of the Normal School of Cookery, who have been admitted by a similar arrangement.

SCHOLARSHIPS.

Although the scholarship resources of the Institute were largely increased by the Perkins bequest of $50,000, in 1887, and by the action of the State in 1888, providing for twenty free students, from as many senatorial districts, the need of further provision in this direction is still painfully felt, especially during the present period of general financial distress. The total income applied to scholarships during the school year, 1893–94, was as follows: the Swett Fellowship, $400; the Savage Fellowship, $400; 20 State scholarships, $4,000; Perkins Fund, $2,350; Rogers Fund, $400; the Sherwin, Farnsworth, Flint, Huntington, Joy, and Loring scholarships, $225 each; the Mirrlees scholarship, $125. In addition to these amounts, the rental of letter-boxes yielded $187.50,

which was applied to the same object. The profits of the Co-operative Society and other minor receipts, to the amount of $462.50 and $500, respectively, were also used.

Students' notes were accepted by the Treasurer for tuition fees to the amount of $2,250. The practice of accepting notes had been discontinued since the establishment of the Perkins scholarships; but last year it appeared necessary to resume it or to leave a number of excellent students entirely unable to continue their work at the Institute. In addition to the two Fellowships, free tuition was granted to five graduates of the Institute, as usual. Since the year closed, a second free-scholarship has been established by Mrs. Mary E. Atkins, to be known as the Elisha Atkins scholarship. The bequest of the late Prof. Sterry Hunt, amounting to $3,000, will become available by next year. The total number of applicants for scholarship assistance, the present year, was 100. About $18,000 would have been required to provide for all the thoroughly deserving cases, instead of the $10,000 available.

It is much to be desired that scholarships should be created in the several towns regularly sending pupils to the Institute, as a reward for thoroughness of preparation, and as a means of helping poor young men to get the education for which their resources may be inadequate. We already have a Milton High School scholarship, founded by the residents of that town; and the Sherwin and Flint scholarships are primarily for the benefit of the graduates of the English High School of Boston. We ought to have a scholarship established for every town in the Boston Basin, and for such places as Cambridge, Somerville, Lynn, Newton, and Brookline, two or three.

Changes in the Faculty and the Corps of Instructors.

With exception of the professorship of Military Science, the appointment to which rests with the War Department,

the changes in the Faculty during the past year have been altogether in the nature of promotions to, or within, that body, no loss having occurred by death or resignation. Associate Professor Despradelle has been appointed to a full professorship. Mr. Fred L. Bardwell has been made Assistant Professor of General Chemistry. Dr. Augustus H. Gill and Dr. Arthur A. Noyes have been made Assistant Professors of Gas Analysis and of Organic Chemistry, respectively.

Mr. Bardwell graduated at the Institute in 1884, became assistant in General Chemistry, the same year, and was appointed instructor in 1886. For eight years he has been in immediate charge of the laboratory of General Chemistry. This very responsible and laborious position demands a teacher of unusual gifts. The work in this laboratory constitutes the first experience which the new students have with experimental manipulation and observation; and their success in subsequent studies must be largely influenced by the training they receive here. Professor Bardwell combines enthusiasm for his subject and zeal as a teacher with good judgment, ready tact, and infinite patience in dealing with new students. The increasing good results of this training during the first year may in large measure be attributed to his faithful work.

Dr. Augustus H. Gill graduated at the Institute also in the class of 1884, and became, first, assistant, and then instructor, in the Chemical Department. He subsequently spent two years in the University of Leipsic, where he obtained his doctorate in 1890. On his return from Europe he resumed his duties at the Institute, and has devoted his time almost exclusively to his special subject, gas analysis. Dr. Gill has brought this important branch of chemical investigation to what is believed to be an unsurpassed degree of efficiency, as regards both instruction and equipment. His classes include not only the men in the chemical course, but nearly all the students of engineering, to whom a knowledge of the composition of furnace and flue gases is a matter of great economic importance. Dr. Gill has also charge of the

fourth-year classes in Applied Chemistry in the Course in Chemical Engineering.

Dr. Arthur A. Noyes graduated at the Institute in 1886; continuing his studies for an additional year, he obtained the degree of Master of Science, and became an assistant in Analytical Chemistry. In 1888, he went to Europe and studied under Ostwald at Leipsic, obtaining his doctorate in 1890. Returning to the Institute in that year, he was appointed instructor in Analytical Chemistry. The following year he was transferred to the department of Organic Chemistry, where he has served the Institute with distinguished success. Dr. Noyes has made the comparatively new subject of Physical Chemistry his special study, and is already one of the best authorities on this subject in the country. His teaching is characterized by rare scholarship and suggestiveness.

Lieutenant Hawthorne having been relieved, at his own request, from further service at the Institute, Capt. John Bigelow, Jr., of the Tenth United States Cavalry, was assigned to duty as Professor of Military Science and Tactics. Captain Bigelow's scholarly tastes have been manifested in an important treatise, "The Principles of Strategy," illustrated mainly from American campaigns. His military record is, briefly, as follows: — He was graduated from West Point in 1877, and commissioned Second Lieutenant of the Tenth Cavalry. He served in Texas from 1877, to the close of 1879, when he was assigned to duty as Instructor in the Department of Modern Languages at West Point. In 1884, Lieutenant Bigelow rejoined his regiment in Texas; and in the spring of 1885, removed with it to Arizona, where he took part in the operations known as the Geronimo campaign. In 1887, Lieutenant Bigelow was ordered to Washington, where he remained for two years as Adjutant-General of the militia of the District of Columbia. Since that time he has been on duty in the field in the Department of Dakota. He was appointed First Lieutenant in 1883; and Captain, in 1893. Captain Bigelow has taken up his work here with the highest zeal and intelligence, and has already succeeded in making this department of in-

struction far more popular than ever before, as is evidenced by the fact that many members of the upper classes have attended his lectures.

In the Modern Language Department, while there has been no change in the number of teachers regularly engaged, there has been a change in the *personnel*, Assistant Professor Vogel having returned from a year of foreign study and relieved Mr. Meyer in the charge of the classes taught by him very successfully last year. It is much to be desired that the number of instructors in this department should be increased; but, as the finances of the Institute did not allow this to be done the present year, a slight degree of relief was afforded to the instructing staff by the engagement of Mr. Blume to take the class in Spanish twice a week through the year.

In the Mathematical Department, the only change in the instructing staff has been through the return of Dr. Frederick S. Woods from three years of foreign study, relieving Dr. Metzler in the charge of the classes conducted by him. Dr. Woods, who was actively engaged as an instructor in Mathematics at the Institute during the years 1889–91, has spent most of his time abroad in studying with Prof. Felix Klein, at the University of Göttingen, taking his degree there last spring. The department is much to be congratulated on the re-accession of this ripe scholar and painstaking teacher. It is exceedingly desirable that, as soon as the financial resources of the Institute make it possible, an additional instructor in Mathematics should be appointed. The entire time of an additional instructor could be used to excellent advantage in providing for a needed increase in the number of sections of the larger classes, and in giving opportunity for further extension and differentiation of such special courses in Mathematics as are imperatively required for the proper development of the technical departments of the school.

In the Physical Department, the past year has witnessed the withdrawal of one who has been for six years a faithful worker in this department, Edward Collins, Jr., of the class of 1888; and the return from Germany of Dr. Harry M. Goodwin.

Mr. Goodwin graduated with great distinction from the Institute in 1890, and for the two succeeding years remained as assistant in Physics. For the last two years he has pursued his studies at the University of Leipsic, from which he has received the degree of Ph.D., *summa cum laude.* The special work to which this accomplished scholar will devote himself at the Institute will be mentioned in the remarks upon the changes in the courses of instruction.

In the Department of History, Mr. Edson L. Whitney has resigned. His place has been taken by Mr. John Osborne Sumner, a graduate of Harvard College in the class of 1887. Mr. Sumner has spent five years in European study and travel, devoting himself chiefly to mediæval history, literature, and art. At Harvard he had paid special attention to the history of the United States. He is, therefore, peculiarly well qualified for the two subjects assigned to him here; namely, the political history of England and the United States, and the history and literature of the Renaissance and the Reformation. In the latter subject Mr. Sumner teaches, not only the students of the Course in General Studies, but the students in the fourth year of the Course in Architecture, where that subject is immediately connected with their professional work; also those in the Course in Biology. To broad and sound scholarship, Mr. Sumner adds enthusiastic interest in his work, and excellent results may be anticipated from his teaching. Mr. Robert S. Ball has resigned his instructorship in Mechanical Engineering, to engage in professional practice. Dr. William H. Walker, a graduate of the University of Göttingen, has been appointed Instructor in Analytical Chemistry.

The following assistants have been appointed instructors: in the department of Civil Engineering, Mr. J. P. Lyon; in the department of Mechanical Engineering, Messrs. C. E. Fuller, W. A. Johnston, and C. F. Park; in Architecture, Mr. R. S. Shedd; in General Chemistry, Mr. H. R. Moody; and in Mechanical Drawing and Descriptive Geometry, Mr. C. M. Faunce.

The following new assistants have been appointed: George

B. Haven, Samuel G. Reed, and Thomas G. Richards, in Mechanical Engineering; Edward M. Hunt and Frank P. McKibben, in Civil Engineering; F. Jewett Moore, Ph.D., in Analytical Chemistry; Leslie R. Moore, in Industrial Chemistry; Joseph W. Phelan and Walter E. Piper, in General Chemistry; W. Felton Brown, in Freehand Drawing; Minot A. Bridgham, in Woodwork; and Everett H. Masters, in Forging.

Messrs. Oscar W. Pickering, in General Chemistry; Fred A. Wilson and Phillips P. Bourne, in Mechanical Engineering; Otho W. McD. Cushing, in Freehand Drawing; Jesse F. Johnson, in Industrial Chemistry; Gorham Dana and James A. Emery, in Civil Engineering; Henry W. Nichols, in Geology; Clarence M. Brockway, in Woodwork; and William H. Lambirth, in Machine Tool Work, have terminated their connection with the Institute.

Statistics of the Corps of Instructors.

The catalogue of 1894–95 shows the number of instructors of all grades to be one hundred and fifteen, inclusive of those concerned with the mechanic arts, but exclusive of those who are announced as lecturers for the year only. The addition of these raises the total to one hundred and thirty-seven. The following table shows the distribution among the several classes of instructors, with the gain or loss since last year: —

	1893–94.	1894–95.
Professors	19	20
Associate Professors	6	5
Assistant Professors	14	17
Instructors	52	52
Assistants	26	21
Lecturers	27	22
Total	144	137

The reduction in numbers, from 1893–94, is due to the fact that last year, in consequence of the death of Professor Norton and the resignation of Professor Levermore, we called in an extraordinary number of lecturers from the outside.

There appears, likewise, to be a smaller number regularly engaged in the work of teaching. This is due to the return from Europe of two of our young instructors who last year were absent, yet borne upon the roll, while their places were supplied by substitutes.

The instructing staff for the year 1894-95 is distributed as follows among the several departments of the school: —

	Civil Engineering.	Mechanical Eng. and App. Mechanics.	Mining Engineering and Metallurgy.	Naval Architecture.	Architecture.	Chemistry.	Physics and Electrical Engineering.	Biology, Zoölogy, Etc.	Mineralogy, Geology, and Geography.	English History and Political Science.	Language.	Mathematics.	Drawing and Descriptive Geometry.	Military Tactics.	Mechanic Arts.
Professors . . . . (20)	1	1	1	1	2	2	2	1	1	2	1	4	..	1	..
Associate Professors (5)	3	1	1	..	..	..	..	..	..	..	..	..	..	..	..
Assistant Professors (17)	..	3	..	..	1	5	1	..	1	1	2	2	1	..	..
Instructors . . . . (52)	3	5	1	1	2	11	7	2	1	4	3	5	4	..	3
Assistants . . . . (21)	3	6	..	..	..	5	1	1	..	..	..	..	2	..	3
Total. . . . (115)	10	16	3	2	5	23	11	4	3	7	6	11	7	1	6
Lecturers . . . . (22)	1	..	1	..	5	5	7	3	..	..	..	..	..	..	..
Total. . . . (137)	11	16	4	2	10	28	18	7	3	7	6	11	7	1	6

In connection with these references to the Faculty and the corps of instructors, it may be interesting to note that, at the Columbian Exposition at Chicago last year, a Society for the Promotion of Engineering Education was organized, Professors Lanza, Swain, Burton, Porter, and Allen participating in the movement and presenting papers on the subject, Professor Allen acting as Secretary. On that occasion Prof. De Volson Wood was elected President, he being the oldest teacher of Civil Engineering in the country, with a service approaching fifty years. In the meeting held at Brooklyn in

August of this year, there were present Professors Lanza, Swain, Tyler, Porter, and Allen, and also Instructors Stanwood and Robbins. Four papers from the Institute were presented. At the close of the meeting, Professor Swain, the head of our department of Civil Engineering, was elected President for the ensuing year. I may also mention that Professor Swain was appointed by the Mayor a member of the Subway Commission for the City of Boston.

Examinations.

A change of very great importance in the general system of the instruction at the Institute has taken the direction of doing away with a large part of the examinations heretofore conducted. It has long been within the discretion of members of the Faculty to dispense with examinations in the third and fourth years, in such subjects as they might select for that purpose; and this discretion has been availed of to no inconsiderable extent, final marks in those subjects being given upon the strength of the term's work in classroom or drawing-room. But with respect to all the subjects taught in the first year, and to nearly all taught in the second year, examinations have been held at the close of the half-year, and again at the close of the year. The results of these examinations, qualified always to a certain extent by the daily and weekly record of the student, have determined his standing and chiefly made up his record.

This system has not been entirely satisfactory to our teachers, although the evils of examinations are often grossly overstated in public discussion. But the Faculty have not until the last year seen their way clear to institute a reform, or rather to make an advance in this direction. At the beginning of the second half-year, however, — namely, in January, 1894, — an announcement was made that in all but three studies of the first, and in most of the studies of the second year, the students' records would be made up from the results of current work, final examinations being dispensed

with. It was announced that this scheme was adopted only tentatively; and that the Faculty would be governed by their observation of its effects in dealing with the question for the future. So admirably, however, did the change work in respect to the half-year, that, at the beginning of the present session, the Faculty decided to make it permanent.

The Faculty wish to have it distinctly understood that they neither purpose nor desire, so far as they are at present informed, to dispense with all examinations. They believe that the mental attitude of examination is one which the student should learn upon occasion to take. They believe that it is a good thing for a young scholar to be at times required to pull himself together, review his subject, and come up prepared to be examined upon the whole length and breadth of it. This is something which he may be called upon to do in subsequent professional study or after life; and the Faculty believe that the students of the Institute should, from the first, and all through, have this as a part of their training; but they also believe that in the past there have been too many examinations, and that the occurrence of these, at the end of each half-year, has brought too severe a nervous strain upon the students, and especially upon those who were of an anxious and excitable temperament. The reduction of examinations to one-half or less of the former number will suffice to retain in the student the habit of examination, and teach him to get-up all of a subject for a searching review, and at the same time reduce the pressure of the closing weeks of the term to a point which will not be excessive.

The Faculty were well aware, before they took this important step, that it meant a great deal more work for the instructors. The system of final examinations cannot fail to diminish the intentness with which a teacher follows his several pupils from day to day, and from week to week, as to the degree of their progress and efficiency. No matter how conscientious a teacher may be, if an examination is coming, in which he can test the attainments and capabilities of his pupils, he will watch their current work with much less

of closeness and scrutiny. If, on the other hand, the student's standing is to be determined, in the grand result, by the performance of his daily tasks, every instructor must feel under a great urgency to note, each time, as carefully as possible, the character of each student's work, so that at the end he may be prepared to report with justice. In a word, the abolition of examinations transfers the strain from the student to the teacher. All this the Faculty and the corps of instructors fully understood and appreciated when they undertook the new system; and they were glad to take the additional labor upon themselves, in order to afford relief to their pupils. The readiness with which the Faculty made the change in respect to final examinations is not to be compared with the readiness with which they continued the system after trial; our teachers are, indeed, enthusiastic in their commendation of the results. Perhaps the best field for the experiment was in the first-year Chemistry, which constitutes one of the severer courses of that year. Here the results were notably fortunate, the number of students receiving "Credits" being largely increased, while the number of failures was largely diminished. The students knew from the beginning that they were every day making their own record; and that no cramming or grand effort toward the close of the term would suffice to make good any degree of neglect or inattention during the earlier part of the course. This rendered them anxious from the first to understand all the matters brought before them, and caused them to resort to the teacher for explanation or for additional information, if they were not satisfied that they had really got hold of the subject. On the other hand, Professor Pope and his associates threw themselves into the work with energy and enthusiasm, determined to make the scheme a success, and carefully looking after every student who, from any cause, seemed to be dropping behind in his studies.

But, while the system of dispensing with final examinations for a great part of the subjects taken, has thus been shown to be successful, provided students and teachers co-operate to

make it so, it ought to be very strongly and positively stated that such a system would be ruinous to the scholarship of any institution where a high standing was not continuously maintained, and where teachers were not scrupulous and conscientious in giving marks. Where laxity in these respects exists, the adoption of this scheme would be fraught with the greatest danger. Even the most indulgent or indolent instructor finds himself keyed up to a certain degree of judicial severity on the occasion of a semi-annual examination; and he cannot possibly allow inattentive or unfaithful students to pass from one class to another without at least knowing that he does so. Remove this safeguard from the instructor; and the tendency to looseness, easy good-nature, and unfaithfulness in teaching will be multiplied many fold. The Corporation, however, need feel no anxiety regarding the result at the Institute of Technology. The standard of scholarship here has ever been maintained with absolute honesty and unwavering fidelity.

In this immediate connection, the Corporation will be interested to learn that the Faculty have abolished the "Honor" mark at examinations and in reports of term-standing. The Faculty have been moved to this by the feeling that some young men, after mastering their subject as far as would really be needed for scholarly, or for subsequent professional, purposes, have been prompted, by too keen an ambition for a conspicuous record, to exert themselves unduly. The abolition of "Honors" leaves the "Credit" mark the highest given. This means that the student has done well; and well is enough.

Official Advisers.

Another step which has been taken for the benefit, as is hoped, of our students, during the past year, has been the institution of a system by which each new student, on coming to the Institute, whether as a first-year student or to enter one of the upper classes, receives a note from the

office of the Secretary, informing him that some member of the Faculty or staff of instruction, named therein, has been asked to act as his adviser. The number of students thus introduced to an individual member of the instructing staff averages between four and five. The system was put into operation at the middle of the last school-year, and was again brought into use at the beginning of the present year. The Faculty do not look to it for any very great effect. It is not intended that the advisers thus constituted shall become in any sense the guardians of the students assigned to them; nor does the Faculty by this action assume any responsibility for the conduct and deportment of the students outside the halls of the Institute. The object of the rule is only to give each student, newly arrived, the means of readily obtaining friendly advice and, possibly, assistance upon any or all matters of interest to him. It is, of course, to be anticipated by every one who knows anything about boys and young men, that some students will be shy and backward in availing themselves of the proffered service. Perhaps the very men to whom the system, if availed of, would do the most good, will be in this class. There are all kinds of young men; and among the students of any institution there will be some who will not readily respond to personal advances. But it is believed that by far the greater part of the students of the school, on arriving at the Institute, will make use of the opportunity thus afforded them to form a personal acquaintance with the instructor; while, in many cases, the slight acquaintance involved in the formal carrying-out of this rule will lead to friendship, perhaps to personal intimacy.

Instruction in Military Science.

By the requirements of both the Act of Congress, July 2, 1862, and the Act of the General Court of Massachusetts, April 27, 1863, military instruction is required to be given to the students of the Institute of Technology. That instruc-

tion is, for reasons which seem good to the Faculty, given to the students of the first year.

I spoke of the past history of this department, in my Report of 1892. I will now speak of the instruction as it has been rearranged by the Faculty, in conference with Captain Bigelow. All students of the first year are required to take this course unless excused on the ground of being aliens. Inasmuch, however, as many of the young men may, from one cause or another, be disabled for actual drill in the ranks and with arms, a standing committee of the Faculty hears all applications for excuse on physical grounds; and the students thus excused are required to take the course known as B. The remainder of the class take the course known as A, which embraces both practical and theoretical instruction, comprising one lecture and one drill of two hours per week. The lectures cover the subjects of strategy, tactics, and fortification.

For the purposes of the drill, which, by the courtesy and hospitality of the Commonwealth and of the officers of the First Regiment of Massachusetts Infantry, takes place in the South Armory, the corps of cadets is organized as a regiment of two battalions of two companies each. The number of students composing the battalion is two hundred and seventy. A new uniform has been adopted, consisting of a cap, blouse, and trousers of dark blue, of the same pattern as that of the undress uniform of the United States army.

Course B, arranged for those students, fifteen in number, the present year, who have been excused from actual drill, consists of two lectures a week. The lectures cover about the same ground as those given in Course A, but are supplemented by additional illustrations and theoretical problems. Extensive notes, with diagrams and illustrations, are prepared by Captain Bigelow, and printed by the Institute from time to time, to be used in connection with these lectures. These notes will aggregate a small volume of perhaps two hundred pages. In arranging the order of instruction, Captain Bige-

low has, for what seem to me excellent reasons, departed distinctly from the practice usual in military schools, where tactics are taught before strategy. Captain Bigelow's reasons for inverting this order are first, that, to the average mind, strategy is much more interesting than tactics, and he thinks it best to try at the outset to awaken an interest in the course and thus secure the attention of the class; secondly, that the students are better prepared on an average, when they enter the institution, for a course in strategy than for a course in tactics, the former being far less technical.

The following account of the course of instruction in the Armory may not only have interest in itself, but may indicate how far the system of organization and discipline pursued may be of professional use in after life in dealing with bodies of men. As soon as practicable after the cadets are enrolled, the four best qualified are selected to fill the positions of captains. For this purpose two examinations are held, — one in writing, covering the drill regulations as far as the school of the battalion, inclusive; and one in drilling and commanding, which is held in the Armory. All cadets are allowed to take part in the first of these examinations, and all who reach a certain standard there are allowed to take part in the second. The captains being appointed, they recommend, from among the cadets who have passed the before-mentioned examinations satisfactorily, the officers and non-commissioned officers for their respective companies. Every company lieutenant and non-commissioned officer is appointed upon the recommendation of the company commander, who is held responsible for the standard of instruction and discipline attained in his company.

Each company is divided into four squads, each comprising one sergeant and one corporal. The sergeant, as chief of squad, is responsible to the captain for the progress made in his squad; each lieutenant is given two squads to superintend. The drill commences with the school of the soldier without arms. Each cadet, as he qualifies therefor, is examined by the commandant with a view to his advancement

to the school of the soldier with arms. If he passes this examination, he drills in the advanced school of the soldier until he passes an examination for promotion to the school of the squad. In this school, he practises marching in line, turning, wheeling, and the firings. The squads are drilled in this collective school until they are found by examination to be proficient, when they are consolidated into companies. The companies are similarly examined before they are consolidated into battalions. The smallness of the battalions resulting from the regimental organization insures to each battalion sufficient room, — each battalion having the whole drill floor in turn; and a small battalion can execute more movements in a given time than a large one. The regimental organization, moreover, provides for the appointment and training of a larger number of field and staff officers than would be the case with only one battalion.

The military department aims at instructing the cadets not only as soldiers, but as citizens. As soldiers, they are taught a certain amount of military science, which may be regarded as a fair foundation for such study as they may care to pursue as militia or volunteer officers, and are familiarized in the Armory with the system by which raw recruits are qualified to take their places in the ranks. There is not time to instruct them in marksmanship; but every cadet is put through a systematic course of drill in the other regular exercises of a young soldier. The object is not to make a model organization, but to afford an object lesson in the system by which an organization is produced from raw material. In this country, if not in every country of the present day, it is the people and not the soldiers who decide the great question of peace or war, and determine the military policy of a nation. The course of instruction is directed with a view to preparing the graduates of this institution for an intelligent discharge of the duty of citizenship in time of war or of rumors of war; to forming among them centres of sound public opinion in military matters. It aims also at contributing to the effect of the literary and historical courses of the institution in broadening

the minds of the students by instructing them outside of their strictly technical departments. The science of war is deemed worthy of consideration as an element of liberal education. What the students learn at this institution of the theory and practice of war can hardly fail to increase their interest in the large province of general history which is taken up with the description of wars. Though war should cease forever, the study of war will ever be profitable as the key to the significance of a vast literature. A term of service as a cadet at the Institute may assist the student of history, as Gibbon's experience in the militia helped him to write his story of the Decline and Fall of the Roman Empire.

The Libraries.

The growth of the libraries during the past year has been marked by a considerable decrease in the number and cost of books purchased, and by a much larger increase in the number and value of gifts. The following table shows the growth for the last five years.

	1889–90	1890–91.	1891–92.	1892–93.	1893–94.
Accessions by gift . .	850	2,737	1,470	2,072	3,204
Accessions by purchase	1,446	2,002	2,354	2.448	1,936
Accessions by binding .	159	452	430	630	730
Total accessions . .	2,455	5,191	4,254	5,150	5,870
Cost, including binding	$2,249.83*	$4,221.00	$4,564.86	$5,146.41	$4,789.69

The net accessions have been 5,652, of which 4,045 are volumes and 1,607 are pamphlets. The distribution and cost of these accessions and the total number of volumes in each departmental library are shown in the following table: —

* Exclusive of binding.

Library.	Volumes added.	Pamphlets added.	Cost.	Pamphlets (bound and unbound) already catalogued.	Total number of volumes.
General	721	471	$354.14	2,568	3,814
Engineering.	877	236	1,374.95	2,360	5,424
Mining	106	55	120.70	238	1,382
Architectural	180	47	240.40	138	1,382
Chemical	382	158	661.16	1,310	5,805
Biological	189	71	324.79	277	1,612
Physical	516	83	735.39	586	4,361
Political Science . . .	752	170	663.04	2,387	6,764
English	188	4	221.49	35	1,838
Geological	132	311	93.63	598	1,520
Margaret Cheney Room	2	1	. . .	12	562
Totals.	4,045	1,607	$4,789.69	10,509	34,464

The number of periodicals received has been 419, and of annuals and serials, — not including official reports, — 96, a total of 515. The cost of the periodicals has been $1,515.21, and the expenses of the librarian's office $119.50, making the total amount spent on the libraries, exclusive of salaries, $6,424.40; 4,057 cards have been added to the main catalogue, which now contains 31,739 cards; 951 orders for binding have been given, covering 1,716 volumes, at a cost of $1,206.72. 1,253 separate orders for books were given; 212 were returned to the departments as duplicates, of which only 23 were re-ordered.

During the year a shelf-list of the Chemical Library has been prepared, under the direction of the librarian, in such a manner that it serves as a partial substitute for a regular subject-catalogue. The completion of this list made it possible to take an account of stock in the library for the first time. The great need of this was proved by the fact that over 200 discrepancies were found to exist between the cards and the shelves or pamphlet boxes, and over 150 volumes and pamphlets were missing. Many of these were simply out of place in the library; others were found by a careful search through the laboratories and offices of the department, having been taken out without registration. There were left unaccounted for,

finally, 20 volumes and 11 pamphlets, as the total loss in eight years from a library now amounting to nearly 6,000 volumes and 4,000 pamphlets. A similar examination of the Physical Library showed a loss of five volumes during the past year. From the Engineering Library, only two volumes were lost, although many more had been taken out by instructors without registration. As these three libraries contain one-half of all the books in the Institute, a total loss of about 20 volumes a year is indicated. It is desirable that shelf-lists of the other libraries should be prepared; but the work of the librarian's office is so great, at least during term time, that these cannot be undertaken.

As has been stated before, the gifts of the year have been larger and more valuable than usual. Besides the many gifts of single or a few volumes, the Institute has received and placed on the shelves the following: —

From the United States Government, largely to complete our sets, 300 volumes and pamphlets.

From Mrs. Henry Draper, of New York, 195 volumes, including many illustrated architectural works, and valuable sets of scientific periodicals.

From Dr. H. Carrington Bolton, of New York, 126 pamphlets, mainly on chemistry.

From Dr. Henry P. Quincy, from the library of the late Edmund Quincy, Jr., 71 volumes.

From the Honorable George Duncan, of Boston, 22 volumes on engineering.

From Mrs. William B. Rogers, $200 for the purchase of periodicals.

The purchase of books from the Pope Fund has been continued.

Printed Notes.

In a previous Report I referred to the practice which has grown up at the Institute of printing extensive notes, with tables, diagrams, etc. for the use of students in the several departments. Few features of our scheme of instruction are

more characteristic than this: indeed, it is fairly a question whether without it we could possibly carry forward our more technical courses, keeping not only abreast, but ahead, of professional practice. Text-books, as is well known, are often from five to fifteen years behind time. A reference to the details of the Treasurer's Report, accompanying, will show that during the fiscal year, 1893–94, an expenditure on this account reached the surprisingly large total of $3,276.20. These notes are sold to students at cost. The receipts from this source were $2935.31. The difference may be assumed to represent the balance of notes on hand, most of which will be disposed of during the present year.

SUMMER SCHOOLS.

The Summer School in Topography, Geodesy, and Geology was held during June last, at Keeseville, N. Y., the same location in which the school was held in 1893. Eighteen students were in voluntary attendance, being more than one-half the total number of students in the Junior year in Civil Engineering. The work was conducted by Professors Burton and Porter, assisted by Mr. Robbins, Instructor in Civil Engineering, and by Messrs. Nichols and Stose of the Geological Department. The plane-table survey of the surrounding region, which was begun in 1893, was extended over an area of 1,600 acres. The base line was again measured, the experiment being made this year of using a brass tape in conjunction with a steel tape. Besides the work during the day, measurements were, for the first time, made during the night, thus gaining the most uniform atmospheric conditions attainable. This year, for the first time, work was done with the new precise level, a line of levels being run along the bank of the Ausable River. The hydraulic work was much the same as last year, and consisted of measuring the discharge of the Ausable, and that of the flumes at Keeseville, with floats and current-meters of various kinds. The current-meters were also rated in the lake. The geological work consisted in

making geological profiles, in studying the geology of the surrounding country, and in visiting various points of geological interest. Many interesting specimens of rocks and fossils were obtained. The school was in every way successful and satisfactory.

The Summer School of Mining last June was held in Nova Scotia and Cape Breton. Eight days were devoted to the study of mining and milling at Waverly, near Halifax, where the mines are managed by Mr. J. E. Hardman, M. I. T., '77. Here we see, adapted to Nova Scotia conditions, the modern method of mining, whereby the work of prospecting of ore-bodies is kept well in advance of the work of extracting the ore, thereby transforming the industry from a fluctuating, now prosperous, now declining business, into a steady industry, in which a number of years of profitable work can be seen ahead, and the financial and engineering plans worked out to the best advantage. The work done by Mr. Hardman has shown that the pockety mines of Nova Scotia lend themselves readily to this treatment. His handling of the gold-milling problem has been quite as systematic. In such a well-ordered establishment as this the students had a fine opportunity for professional work, and they availed themselves of it with the greatest eagerness.

In Cape Breton, three weeks were spent by the students as guests of the Dominion Coal Company. The company has adopted the system of mining coal, generally, by the methods and appliances that were in use at the time of purchase of the different properties, but replacing the older methods with new and modern ones as rapidly as their efficiency could be proved and their adoption safely effected. Under these conditions, the company selected the Gowery Colliery at Cow Bay as that best adapted for the Summer School. In it the students spent a period of ten days, and had a fine opportunity to look into the methods of mining levels and rooms, of leaving pillars to support the roof, and into all the operations included in excavating, hoisting, and shipping coal. In another part of the Dominion Coal Company's property, — namely, on the Vic-

toria Areas, — the company had a stratigraphical problem on their hands. Authorities disagreed in regard to the continuity of a certain coal-seam. The students had the great privilege of working upon this problem, and were so fortunate as to gain facts which pointed toward its definite solution. It was here they obtained their practice in geological investigation.

The party was divided for the Cape Breton work, one squad working at the Victoria areas with Professor Richards, the other at Cow Bay with Professor Hofman and Mr. Lyon. At the end of ten days the squads changed places, each picking up the work where the other had left it. During the stay in Cape Breton, the Dominion Coal Company placed every facility at the disposal of the Summer School in the most liberal and kindly way, even to the furnishing of a guide to the geology of the region. The thanks of the members are especially due to Mr. John E. Hardman, of Nova Scotia, and to Messrs. H. M. Whitney, David Mackeen, J. S. Lennan, J. W. Revere, T. J. Brown, and A. M. Evans, Officers of the Dominion Coal Company. Before returning home, the whole party spent a very instructive day at the Sydney Mining Company's mine, and enjoyed the hospitality of the manager, Mr. Brown. On the Fourth of July they visited the Coxheath Copper Mine, and were hospitably entertained by Colonel B. Granger and President I. P. Gragg.

The Summer School of Architecture was begun in 1893 at Chicago, the World's Fair offering an exceptional opportunity for comparative study of both foreign and domestic art and construction. In 1894 the school was held in Salem, Portsmouth, and vicinity, for the study of colonial architecture. The class was met everywhere with the greatest courtesy, and the result is a great amount of measured work with sketches and photographs. The study of this architecture is of peculiar value as being the only historical precedent we can refer to in this country. We are also in the centre of the choicest of this work, and in the future we hope to make an exhaustive study of it. The work of both years has been under the supervision of Assistant Professor Homer.

The past year has also witnessed the tentative introduction of a limited amount of summer instruction in the laboratories and lecture-rooms of the Institute, by members of the instructing staff, though not as a part of any required course. These summer classes had the character of private instruction, and were conducted without expense to the Institute. While receiving Faculty sanction, they were conducted without supervision, or assumption of responsibility, on the part of the Faculty. The courses were primarily intended for the students of the Institute, but were open to other persons who could show suitable preparation. Nearly all of them were embraced within the first six weeks of the summer vacation.

The first proposed and the largest of the summer classes was that in Analytical Chemistry, conducted by Professor Talbot, with an attendance of twenty-four. This number included students who availed themselves of this opportunity to make up arrears; students who desired to obtain practice in chemical manipulation, in addition to that possible in the hours allotted to chemical work in their respective courses; students taking Institute courses in which Analytical Chemistry is not regularly included; and two persons not students at the Institute. A course in General Chemistry, designed with special reference to the needs of teachers, was given by Professor Bardwell, beginning in July, and was attended by three persons, not students at the Institute. Dr. Evans also conducted a course which included Organic Chemical Analysis and Organic Preparations. This was attended by five from among the students of the chemical course who had completed the work of the third year.

In the Department of Languages, Professors van Daell and Dippold presented a course of instruction in French and German, which was attended by eight students. Mr. Wendell gave a course of lectures and recitations on General Physics, with three students. The Mathematical Department presented two courses, — that by Mr. George, on Integral Calculus and Analytic Geometry, attended by six students, and that by Mr. C. M. Faunce, on Descriptive Geometry, attended by eight students.

The small attendance at many of these courses was doubtless due to the lateness of the conception and execution of the scheme, the announcement having, for reasons applying to the past year, been made but a very short time before the school closed. The earnest spirit manifested by those who did avail themselves of the advantages offered furnishes unquestionable evidence that there is a real demand for such opportunities to utilize a portion of the long summer vacation in making up arrears, or in gaining additional experience in professional work. It is probable that the Faculty will authorize the continuance of the system thus begun, and that upon a larger scale.

Gymnastics and Athletics.

In considering the matter of gymnastics and physical exercise at the Institute, it should be borne in mind that a very large proportion of our students do not reside in the vicinity of the school, but have their homes in the suburban districts and towns, or even at a considerable distance from Boston, as shown in my last Annual Report. These students must, in general, be presumed to get their exercise at home, or to take it in their coming and going. In the first year, also, the military drill answers many of the purposes of a gymnasium, not only in the actual exercise involved, but also in "setting up" the men and teaching them how to carry themselves easily and well.

It is gratifying to report a continued increase in the use of the gymnasium. The instructor in charge, Mr. Herman Boos, has shown intelligence and zeal in promoting physical exercise, and in forming classes for systematic bodily development. These classes are given regular practice, five afternoons in the week, with the dumb-bells, Indian clubs, chest weights, etc., as well as in the so-called "apparatus" work. The large floor of the gymnasium, 150 by 50 feet, is first subject to the demands of the regular classes; but, in addition to these, great numbers of students, many of them already well instructed, pursue feats and games at their own pleasure, while

the members of the several "teams" prepare themselves for the contests before them. It is much to be regretted that the Institute has not an athletic field and larger gymnasium facilities. At the same time, the position of athletics here is not by any means unsatisfactory. The students in general understand perfectly well that this is a place for men to work, and not for boys to play; and they organize their athletic teams and carry on their contests in a very sensible and practical spirit. It is, of course, impossible to organize championship teams without a very large sacrifice of scholarship; but our young men, without, for example, entering any foot-ball league, play with all comers for sport and exercise. This is the spirit in which athletics should be pursued in an institution like our own, where the demands of scholarship are severe. On the other hand, in individual athleticism, where the requirements of practice are far less exacting, the Institute men do exceedingly well. At the athletic "meet" in Worcester, in the spring, our students encountered competitors from ten colleges of New England, and carried off the honors by the very handsome score of thirty-eight out of one hundred and twenty, making, it will be seen, almost exactly one-third of all the points. Such a result shows that in respect to individual physical development our students suffer by comparison with no institution; and that failure to receive championship honors in team-work is due, not to lack of strength or of swiftness, but to the fact that study is here held to be the prime object of college life.

Association of Agricultural Colleges.

During the year the Institute has become a member of the American Association of Agricultural Colleges and Experiment Stations, which now includes nearly all the institutions receiving aid under the Morrill Acts of 1862 and 1890. The Secretary of the Faculty, Professor Tyler, attended the Annual Convention at Washington, in October last, as a representative of the Institute. In many States, those colleges represent the

highest educational standards there existing; and the further co-operation of the Institute is desirable, not only on account of our common interest in matters of legislation, but as a means of strengthening the general cause of education in the mechanic arts contemplated by the original Act of 1862.

The New Boiler-House.

There have been no structural changes in the buildings occupied by the Institute during the past year. An addition has, however, been made to our plant by the construction of a boiler-house on the Trinity Place lot, from which the engineering and the architectural buildings will hereafter receive steam directly, for heating and for power. Five years ago, when the Engineering Building was constructed, it was decided to send over the steam from the basement of Rogers Building, through a six-inch pipe, having the Emery system of joints and packing. This system has been in use now for five years, with a tolerable degree of success; but the increasing leakage from the settling of the ground and the constant imminence of a possible disruption, which would leave these two important buildings for some time without steam either for heating or for power, taken in connection with the increased demand for steam due to the construction of the Architectural Building in 1892, and the steadily extending work in the Laboratory of Steam Engineering, — all these causes combined to make it undesirable any longer to supply the Trinity Place buildings from the central battery. A boiler-house, thirty-four by forty feet, containing two one-hundred horse-power boilers, from the Roberts works at Cambridgeport, has accordingly been erected during the past summer, and is now in use. It is believed that the economy of coal thus effected will offset no inconsiderable part of the cost of constructing and maintaining this new source of steam supply. At the same time, I am disposed to think that the action taken in 1889, in respect to this matter, was wise, under the circumstances existing at that time.

We were not in possession of either the skating-rink lot or the Jordan land. It would have been impossible for us then to determine upon the best location for a steam plant. Any decision we might have reached in regard to a boiler-house for supplying the engineering building alone would have been very likely to prove unfortunate with reference to the entire tract we now own. I believe that it was worth all it has cost to postpone the decision of that issue.

The Courses of Instruction.

Mathematics. — The advance in the entrance-requirements in Mathematics, referred to last year, has now taken effect on the work of the present first-year class. Of the optional requirements in Advanced Algebra or Solid Geometry, about three-fourths of the applicants offered the latter, and the results of the examinations in both subjects were as favorable as could have been expected. Of the June applicants the present year, only fifteen entered with conditions in Solid Geometry; only five with conditions in Algebra. The mathematical work of the first year now begins with Algebra for those who have passed in Solid Geometry, and with Solid Geometry for those who have passed in Advanced Algebra; but becomes uniform for all upon the introduction of Trigonometry, at the end of eight weeks. The question of a further rearrangement of mathematical courses in the second and third years is still under consideration by the Faculty.

A few years ago the Mathematical Department obtained a number of models; and it was then the expectation that this collection would be increased by similar amounts from year to year. If this expectation had been realized, the department would now be in possession of a complete set of these extremely useful aids to mathematical instruction. No additional models have been acquired as yet; but it is hoped that provision may soon be made for this object. The department also feels very strongly the need of a few hundred dollars for the purpose of supplying the library with

standard works published in the past, the annual appropriation being hardly more than sufficient to provide for new publications.

History. — In my Report of last year, I explained the measures which the Executive Committee had taken to meet the exigencies arising from the unexpected resignation of Professor Levermore. The members of the Corporation will remember that the vacancy thus created was to a considerable extent met by the appointment of special lecturers for the year; namely, Dr. John Fiske, of Cambridge, and Professor Jameson, of Brown University, in American History; and A. Lawrence Lowell, Esq., of Boston, on the Recent Political History of Europe. In addition to these powerful reinforcements to the Department of History, an additional instructor was appointed. Of the work thus provided for, as well as his own, Professor Currier assumed a general oversight, and conducted the department during the year with marked ability. A special effort was made to improve the history given to the whole class, in the second term of the first year; and it is believed that the decided success achieved will be made permanent. More satisfactory results at this stage cannot fail to have a favorable influence on the subsequent historical and economic studies of the class. For the present academic year, it has not been thought necessary to secure lecturers from abroad, the force having been sufficiently strengthened by the appointment of Mr. Sumner.

Modern Languages. — The department library is increasing as fast as its slender appropriation allows. The policy has been to buy standard books of reference, and this should be continued for years to come. I have already referred to the importance of an increase in the number of teachers in this department. We ought to have one more instructor in French, and one more in German, so as to give each pupil a larger amount of personal drill. One point of extreme importance in regard to the modern languages is our relations to the preparatory schools. If we could ask, and I feel that the time is drawing near when we can ask, the offering of both

elementary French and elementary German, or, as a substitute an advanced examination in one of the two languages, our Institute course might take what must be its ultimate shape, namely, a more special training in the use of scientific French and scientific German, and, not least important, direct the students toward a broader comprehension of the literatures both of France and Germany, and of the civilizations of these countries. Then it would also become possible to develop options, either in the more advanced study of French or German, or in Spanish or Italian; and this could be done without encroaching at all on the attention necessarily given to technical studies. Indeed, in many cases we might expect to relinquish a part of the claim which the Modern Language Department must now make on the time of nearly all students. The schools are in many cases ready and even desirous to meet us; the circle of careful and consistent preparation is enlarging every year. Many institutions, even in distant parts of the country, are trying to introduce the New England standards. This must soon bring with it, as a matter of course, the ready acceptance of enlarged requirements.

English. — The policy of the department is to emphasize two lines of work. The first is the training of the student to write correct and practical English; the second, the broadening of his thought and culture through appreciative familiarity with literature. The correction, by this department, of technical memoirs prepared in other departments, is found to be most advantageous; and the continued effort is to make all work in composition as practical as possible. In regard to literary training, it is felt that, although so much time is necessary for the technical training of students, attention should still be given to general culture. The need of broadening the mind is all the greater because of the tendency to concentration which is the inevitable result of technical courses. A change has been made in the course of literature which is given to all second-year students. The entire class is now brought together for weekly lectures by the head of the department, and is divided into sections for further instruction and for

written work. This method promises good results, and is apparently regarded with favor by the class as well as by the instructors.

Having spoken thus far of matters common to all departments of the school, or to several of them at once, let me now proceed to speak, in more detail, of things which particularly concern individual courses.

Courses I. and XI., Civil and Sanitary Engineering. — I have already mentioned Mr. Lyon's appointment as instructor. Inasmuch as the number of assistants is the same as last year, the total teaching force of the department has been increased by one instructor. The number of students in the two courses is greater than ever before, the total in the three upper classes being one hundred and one. No important changes have been made in the course of study, which is found well adapted to the needs of the profession. Increased attention is being given to instruction in Geodesy, though it is not expected that the number of students desiring to pursue this subject in detail will be large. The geodetic work in the room on Myrtle Street, which was referred to in the last Report, was continued throughout the past year, to the great advantage of the students in the geodetic option. This year a similar room will be engaged during the second term. It is again necessary to emphasize the pressing necessity of our having a separate building, on firm ground, suitable for the special work in this option. A feature of the work last year was the series of pendulum observations carried on at the State House by two observers from the Coast Survey, sent here by Professor Mendenhall, Superintendent of the Survey, at the suggestion of Professor Burton, for the special purpose of determining the value of the force of gravity by pendulum observations. The students in Geodesy were permitted to take part in the work. A separate pier for the astronomical transit was erected at the expense of the Institute; and through the kindness of the architect of the State House Extension, Mr. Charles Brigham, a room was secured in which the pendulum observations were made. In the development

of the geodetic work, the transit used in running the line of the Hoosac Tunnel, which was obtained from the State some years ago, is now being altered so that it may serve as an astronomical transit and zenith telescope, for time and latitude observations. With this and the German altazimuth instrument purchased a short time ago, together with our usual instruments, we are sufficiently equipped for giving such a course in field astronomy as is necessary in a school which does not undertake to teach astronomy in detail. If the work in geodesy is to be still further developed, the special building referred to should be provided, and equipped with some additional instruments, such as pendulums, chronometers, and chronographs. Unless additional space is given, the geodetic work cannot be developed much, if at all, beyond its present condition, although the class-room instruction will, of course, be made to keep pace with the advances in the science.

The apparatus in the Hydraulic Laboratory has been increased since my last report by two very important pieces of apparatus; namely, a Pelton wheel and a large weir tank. The Pelton wheel is four feet in diameter, giving about thirty horse-power under a head of one hundred feet. This head has several times been exceeded in the work of the laboratory. The wheel is set up complete, with gate, piezometer connections, and brake, so that it can be and is regularly run in class tests; and the wheel itself is enclosed in a wooden casing with glass sides, so that its operation can be seen. It is, in every respect, a very interesting piece of apparatus, and a valuable addition to the equipment of the laboratory. The weir tank is about five by ten feet, and three feet high, is arranged with screens, and conforms in all respects to the conditions necessary in a standard weir. Moreover, the length of the weir is adjustable, so that complete sets of experiments can be carried on for determining the coefficients of discharge for weirs of different lengths, thus giving an opportunity for working in a field where experiments have been much needed; namely, with very short weirs. The weir can, moreover, be transformed into a weir

without end contraction; and the whole tank is so designed that it can be attached to the iron supply-tank, and used in connection with various other pieces of apparatus.

A Darcy-Ritter tube, of the standard French type, has been procured for gauging the flow in streams. This instrument, though used very commonly abroad, is seldom seen in this country. It was employed by our students in the work of the Summer School. The use of the nozzle, for measuring quantities of water, has assumed considerable prominence in the laboratory. It will be remembered that such a use of the nozzle, and the fact that, if properly made, it would serve as an extremely accurate water-meter, were first pointed out by a member of this Corporation, Mr. John R. Freeman. The experiments made in our laboratory have proved extremely satisfactory, and several new nozzles have been procured during the past year. In each case the nozzle is calibrated by direct measurement of the quantity discharged, thus determining its coefficient. The Blake pump procured last year continues to satisfy all requirements. There is need, however, of another rotary pump. A description of the Hydraulic Laboratory of the Institute was written by Professor Porter, and published in the "Technology Quarterly," the journal of the New England Water Works Association, and in the "Engineering News." There still remain many fields of investigation requiring new apparatus, which we hope in the near future to be enabled to explore. The equipment of such a laboratory should be constantly increased, in order that the experimental work may be varied from year to year, and in order that the Institute may keep in advance in the experimental investigation of new problems in hydraulics.

Special mention was made, in the last Report, of the instruction in Highway Engineering, the development of which is largely due to the liberality of Col. Albert A. Pope. During the past year, this development has continued. Room 46 of the Engineering Building is now used as a museum of highway engineering. In it have been placed a number of full-size models of roads and pave-

ments of various kinds, together with samples of stone blocks, brick, wood, and other materials used in the construction of streets and highways. The Barber Asphalt Company has presented to the department a complete exhibit relative to asphalt pavements, comprising samples of the materials in various stages, with models of pavements and samples cut from existing pavements after different periods of use. Two road-builder's levels have been procured for the instruction in this department; and a new piece of apparatus has been constructed for testing the wearing-power of road-materials of various kinds.

During the past year, in addition to the regular instruction in Highway and Railroad Engineering, as described in my last Report, special lecturers were engaged as follows, — Henry H. Carter, Superintendent of Streets of Boston, upon the Work and Organization of the Street Department; Henry Manley, of the City Engineers' Department of Boston, on Streets and Pavements; Edward W. Howe, Engineer of the Boston Park Department, on Parks; Albert F. Noyes, of the Metropolitan Sewerage Commission, and formerly City Engineer of Newton, on Streets for Suburban Cities; and Ernest W. Bowditch on Landscape Gardening. Mr. Bowditch also lectured on the Plumbing and Drainage of Houses; Mr. Noyes on the Sewerage of the City of Newton; while the lectures of Mr. Freeman on Hydraulics of Fire Protection, and of Mr. Blodgett on Railroad Signals, were given as usual. Acknowledgment is due to President Tuttle of the Boston and Maine Road, General Manager D. W. Sanborn of the same road, and General Manager W. H. Barnes of the Boston and Albany Road, for courtesies extended to our classes, by means of which their work has been greatly facilitated.

In my last Report, I gave some statistics with reference to summer work done by students in Civil Engineering; similar statistics have just been collected for the past year. These show that of twenty-nine students in the fourth year in Civil and Sanitary Engineering, nineteen, or 65.5 %, were employed in engineering work during the past summer. The average

time of employment was about 2.5 months, and the average pay received, about $60 per month. Of the present third-year class, including only men who were in the Institute during the previous year, 15 out of 41, or 36.6%, were employed during the past vacation. The average length of time of employment was about three months, and the average monthly pay received about $45 per month. These last results are less favorable than those of last year; but considering the business depression and the large number of persons, in all branches of industry, out of employment, they are not unsatisfactory. Many students, of course, do not seek such employment.

Course II., Mechanical Engineering. — The following apparatus has been added to the Laboratory of Applied Mechanics; namely: —

1. A pair of plate-holders, to be used with the Emery testing-machine, each weighing about 2,600 pounds, and capable of gripping plates up to eighteen inches in width and three inches in thickness.

2. Some new apparatus for measuring the angle of twist of shafts tested in the torsion-machine, of such delicacy that an angle of four seconds can be measured.

3. A new cement-testing machine, designed in such a way as to effect a gradual application of the load, and to have a large range.

To the other portions of the engineering laboratories have been added: —

1. An experimental steam-engine governor.

2. A four H. P. Otto gas-engine, a gift to the Institute, which will serve to run some of the apparatus which requires but little power, when steam is not available, and also to give the students a little practice in testing gas-engines, until such time as a larger one can be obtained. The four-foot Pelton water-wheel and the adjustable weir have been spoken of in connection with the instruction in hydraulics. Besides the above, the facilities of the engineering laboratories have been much increased by the addition of the two new boilers, in the

new boiler-house adjacent to the Engineering Building already referred to, inasmuch as we thus obtain a larger number of boilers upon which to make tests; and, moreover, care has been taken to insert in the settings, at suitable points, a series of porcelain tubes, from which to obtain draught-pressures and temperatures, and also samples of flue-gases for test; besides which, the new steel stack will furnish the means of experimenting on chimney-draught.

The regular work of the engineering laboratories is so conducted as gradually to accumulate a vast amount of data of value to the engineer, a large portion of this work forming part of some systematically conducted investigation. The desirability of publishing this material was called to the attention of the Corporation by Mr. Mills, in his report as chairman of the Visiting Committee on the departments of Mechanical Engineering and Applied Mechanics, in February last. In accordance with that recommendation, it has been decided hereafter to publish the results of tests regularly in the "Technology Quarterly," at such intervals of time as may seem best; care being, of course, taken to include only results which have been obtained in work done under such supervision as to insure the highest degree of reliability and accuracy. This publication is not to include special investigations made in the course of the thesis-work, since these latter, when suitable for publication, are issued as separate papers, whether in the "Technology Quarterly," or in the Proceedings of some engineering society, or elsewhere. It is believed that the publication of results from the regular laboratory work, as stated, will be of value to the engineering community, and will constitute a service to the public which it is very suitable the Institute should render. The first instalment appeared in the "Technology Quarterly" of July; and the second will appear in the December number. Among the investigations regularly carried on in the laboratory, it may be worth while to mention the following in connection with which a good deal of work has been done during the last school year; namely: —

1. Tests of the triple-expansion engine, under a variety of conditions of steam jacketing, with a view to determine the effect of different combinations.

2. A long series of tests on the Emery testing-machine, to determine the crushing strength of different kinds of wood in a direction at right angles to the grain.

The following is a list of printed notes and of papers published by members of the instructing staff: —

1. Notes on Steam-Boilers (printed for the use of the students), by C. H. Peabody and E. F. Miller, with a chapter on Boiler Design by P. Schwamb.

2. Some Experiences in Engineering Practice, by Hon. George Duncan, published in the "Technology Quarterly" of October, 1894, being the substance of several lectures delivered by him before the students of the Mechanical Engineering Department.

3. A paper on Engineering Laboratories, by G. Lanza, presented to the Society for the Promotion of Engineering Education in August, 1894.

4. A serial paper on Engineering Practice and Education, by G. Lanza, published in the "Journal of the Franklin Institute," beginning in May, 1894, being a series of lectures prepared by the author for delivery before the Lowell Institute, in 1893.

5. Stresses in the Rims and Rim-Joints of Pulleys and Fly Wheels, by G. Lanza, — a paper presented to the American Society of Mechanical Engineers, in December, 1894.

6. The Application of Brakes to the Truck Wheels of a Locomotive, — a paper presented by G. Lanza to the American Society of Mechanical Engineers in December, 1894, being an account of the thesis work of Messrs. F. H. Keyes and John W. Logan, of the class of 1892.

7. Some Tests of Spruce Columns, by G. Lanza and E. F. Miller, presented to the American Society of Mechanical Engineers in December, 1894, being the results of work done on the Emery testing-machine.

8. Tests on the Triple Engine at the Massachusetts Institute

of Technology (2d paper), by C. H. Peabody and E. F. Miller, presented to the American Society of Mechanical Engineers in December, 1894, being an account of the recent results obtained in the course of the investigation which has been already referred to.

9. A Dynamic Steam-Engine Indicator-Tester, by C. H. Peabody and E. F. Miller, — a paper presented to the Society of Naval Architects and Marine Engineers, November, 1894.

10. A New Torsion-Machine, — a paper by E. F. Miller, published in the "Technology Quarterly" of December, 1893.

11. The Efficiency of Jack-Screws, — a paper by E. F. Miller and W. A. Johnston, published in the "Technology Quarterly" of December, 1893.

The lectures given by gentlemen from outside to the students of the fourth-year class in Mechanical Engineering, attended largely by members of other engineering departments, have been of great interest. The list is as follows: —

1. Mr. Taylor gave an account of an experimental investigation, lasting nine years, and made by himself in the machine-shop of the Midvale Steel Company, upon the Transmission of Power by Belting, with a description of the results.

2. Hon. George Duncan, formerly of the firm of Maudsley & Sons, engine-builders, in England, gave several lectures on Some Experiences in Engineering Practice.

3. Mr. Eliot C. Clarke, Treasurer of the Boott Cotton Mills at Lowell, Mass., gave a lecture on the Business Management of Corporations.

4. Mr. George L. Roberts, of counsel for the American Bell Telephone Company, gave a lecture on the Relations of Patent Law to Engineering.

5. Mr. C. C. Bowers spoke on Marine Engineering.

6. Mr. E. V. French spoke to the students of the Locomotive Option on Railroad Signals.

Course III., Mining Engineering and Metallurgy. — In the Mining Department, the year has been a prosperous one. The number of students, regular and special, following the

course gives proof that it is fulfilling its purpose. This year the numbers are: —

Second year	13
Third year	11
Fourth year	13

The work of the department has been continued with unabated zeal during the past year. Three new muffle-furnaces have been added, to meet the needs of the larger classes. A new Deville furnace has been purchased, for testing the fire-resisting qualities of clays at very high temperatures. With this furnace a valuable investigation was made last spring by two students under the direction of Professor Hofman. Two new alidades have been purchased for the plane-table work of the Summer School of Mines. They contributed materially to the geological investigation made in Cape Breton last summer. The library is growing, by the arrival of periodicals and the purchase of new works on Mining and Metallurgy. An investigation has been made by Professor Richards upon the velocities of grains of minerals, of different specific gravity, falling in water. It forms an important contribution to ore-dressing science. The results are already being used in the laboratory for the benefit of students.

Professor Richards is thoroughly revising his notes upon ore-dressing, and will probably visit all the principal districts of the United States, during the coming summer, to obtain the latest practice. The preparation of lithographic notes is being carried on to a greater extent than usual this year. The notes on the metallurgy of iron are being thoroughly revised and rewritten, with a great advantage from the assistance of experts at the works. Mr. J. W. Cabot, M. I. T., '79, is writing up the notes on steel. Mr. R. H. Sweetser, fresh from the works, is writing up the blast furnace; while Mr. W. A. Tucker has searched the literature of the last fourteen years to obtain the best practice. These notes will prove of great value to the students, not only while at the school, but after leaving it. The edition should last five years. Mr.

Lodge is preparing lithographic notes on the laboratory processes, as they are needed. The mining notes will be completely rewritten and brought up to date during the spring term. The fine exhibit of iron and steel products given to the Institute by the members of the Jernkontoret has been received. Four works are represented, — Söderfors, Österby, Horndal, and Ankarsrum. The two latter collections are already installed at the charges of a few friends of the department; the two former are being placed in their cases.

The following periodicals are among the recent accessions to the Mining Library, — Freiberger Jahrbuch; Canadian Mining Review; Journal of the General Mining Association of Quebec; Journal of the Illinois Mining Institute; Ohio Mining Journal; Proceedings of the Colorado Scientific Society; The Clay Worker; Transactions of the Mining Society of Philadelphia; Zeitschrift für Electrotechnik und Electrochemie; Zeitschrift für praktische Geologie.

Course IV., Architecture. — The Department of Architecture opens the year with no important changes in its scheme of study, but with a sensible extension of several of its technical courses. Some of last year's students in the graduate course have returned for still another year of study. The department is aiming to show that a post-graduate course of two years, continuing the same scheme of studies, governed by the same traditions, is of greater value to the student than to split the course by spending part of the time here and part abroad at the foreign schools. School training in the strictly professional work should teach in the highest degree the principles of composition, balance, proportion, and scale. To accomplish this requires years of hard and uninterrupted study, under instruction of unquestioned ability. Then comes the time for a year or more of foreign travel, when the value of the previous training will be apparent in the greater appreciation of historical architecture. Professor Despradelle's first year was a very successful one; and his second year has begun with equal enthusiasm on the part of his pupils. They have themselves created a higher standard for work than is

called for, and which is impossible to restrain. There is a constant appeal for longer hours, and that the library be opened during the evenings. The valuable library of the department and its vast collections of photographs increase every year both by gifts and by purchase. Another, larger and more useful, series of lantern-slides is being made in the department, to illustrate the lectures on ancient architecture. The instructors are the same as last year. Mr. S. W. Mead, of the firm of Cabot, Everett, & Mead, is Instructor in Architecture, with Professor Despradelle. Mr. Mead's scholarly attainments, with his practical experience, make his services peculiarly valuable. The instruction given in Water-Color, by Mr. Ross Turner; in the History of Ornament, by Mr. C. Howard Walker; in Pen and Ink, by Mr. D. A. Gregg; in Modelling, by Mr. T. H. Bartlett, — is of the highest order. Mr. Adams continues to be very successful in his conduct of the life-class. Extending the course in Architectural History has greatly added to its efficiency and interest. The various historical monuments discussed and illustrated in the class-room are now divided among the students as subjects for written themes. The results are successful in every way. This scheme also offers an opportunity for a more thorough knowledge of the contents of the library.

While the whole Institute has suffered a great loss in the death of Mr. Arthur Rotch, the blow to the Architectural Department has been especially severe. He always had its welfare greatly at heart; and his generosity, often appealed to, always responded. He was a constant visitor to the department, and its generous friend both in life and at his death. It was he who contributed or secured the funds for the furnishing of the new architectural building two years ago; and it was to his cordial interest that we owe the presence of the Envois of the Rotch Travelling Scholarship which adorn its walls.

The professors in the Architectural Department, as well as of the whole school, have, within the last few weeks, had special reason to feel proud by reason of the honors won by

three of our graduate students. At the competition held in New York City, by the Beaux Arts Society of architects, this fall, the three men representing the Institute of Technology received, severally, the first, the third, and the sixth prize, from among thirty-seven competitors: the gold medal having been awarded to Mr. F. M. Mann, now a candidate for one of the higher degrees of the Institute; the second "first mention" to Mr. H. H. Thorndike, and the third "second mention" to Mr. W. B. Faville. The competition was open to the members of the Beaux Arts Society, to the students of the departments of architecture in Columbia College, the University of Pennsylvania, Harvard University, the Massachusetts Institute of Technology, Cornell University, and Syracuse School, and to the members of the New York Sketch Club, the Boston Architectural Club, and the Philadelphia T-Square Club. The success of our students in a competition so wide is not only gratifying, as showing the thoroughness of the training received at the Institute, but also as proving that this, the oldest school of architecture in the United States, is abreast of modern thought and professional progress.

Courses V. and X., Chemistry and Chemical Engineering. — Some of the more important matters pertaining to this department have been mentioned in speaking of the changes in the Faculty and the instructing staff of the Institute. The teaching force of the Chemical Department now embraces two professors, five assistant professors, nine instructors, and five assistants, — in all, exclusive of lecturers from the outside, twenty-one.

The number of students in the chemical laboratories is as follows: —

Laboratory of General Chemistry	393
" " Analytical Chemistry	126
" " Organic Chemistry	20
" " Industrial Chemistry	14
" " Sanitary Chemistry	40
" " Textile Coloring	16
" " Gas Analysis	108
Total	717
Deduct for students reported more than once	79
Actual number, in all laboratories	638

There are more students taking Chemistry than ever before, and the present accommodations are insufficient. The Laboratory of Analytical Chemistry is crowded. Originally designed for one hundred and eight students, there are one hundred and twenty-six working in it. The Laboratory of Organic Chemistry is inadequate in size, and additional rooms are needed for physico-chemical work and for recitations.

The course in Chemical Engineering remains still under the charge of Professor Drown, pending the appointment of a successor to Professor Norton. The lectures in the course in Industrial Chemistry are now given mainly by Dr. Frank H. Thorp, of whose appointment mention was made in my Report of 1893, and who began his work as Instructor in Industrial Chemistry in February of this year. As heretofore, many lectures are given by experts engaged in various manufacturing industries. The course in Applied Chemistry in the fourth year is under the care of Professor Gill. The laboratory instruction in Industrial Chemistry and Textile Coloring is maintained in a high state of efficiency by Mr. J. W. Smith. In this connection it may be mentioned that Dr. Lunge, of Zurich, in his report to the Swiss government upon technical education in the United States, speaks of the Laboratory for Textile Coloring and the Laboratory for Water Analysis in the Institute of Technology as models in arrangement and equipment.

It is interesting to note the increasing aid which the different departments of the Institute give to each other in the course of their growth and development. The courses in Chemical Engineering and Sanitary Engineering represent the demand for young engineers who shall have a fair knowledge of Chemistry and Biology in addition to their training as mechanical and civil engineers. The relations of the chemical and physical, and the chemical and biological departments are likewise becoming more intimate each year. Chemistry and Biology occupy common ground in many matters relating to hygiene, sanitation, fermentation, and like subjects. The intimate connection of these departments is well shown in

the great investigation of the Massachusetts State Board of Health into the purity of the natural waters of the State, and into the means best adapted for the disposal and purification of the sewage of inland towns. This investigation, which is still in progress, has been for the last eight years under the charge of the heads of our chemical and biological departments. This increased usefulness of the Institute is the natural result of its wide scope and the high specialization of its corps of teachers.

The references which have been made to the chemical instruction at the Institute lead me to speak somewhat at length of the nature and extent of our courses in Theoretical Chemistry. Perhaps in nothing is popular opinion regarding this school more persistently in error than in supposing that the instruction here is almost exclusively professional and technical. The fact is, vastly more time has always been devoted at the Institute to scientific than to technical study; while, even in the technical applications of science, reference is had far more to their effect in impressing scientific principles upon the minds of the pupils, and in teaching them how to apply scientific principles to actual problems, than to the practical value of the technical methods and arts thus taught. The primary object in all teaching here is to fit young men for active work, through training them in independent thought and investigation, by which means only can they be taught self-reliance. This, in the Chemical Department, can, it is believed, be best accomplished by great thoroughness of instruction in chemical processes, combined with research work in the library on the part of the student, in order that the critical faculty, so important in a rapidly growing science, should be developed. With such a system of teaching as this, it is impossible to cover as wide a range of work as is done in many technical schools; but the results of the system in developing and maturing the students as independent thinkers, fully justifies this limitation as to the variety of the subjects which are given them to investigate. The foregoing statements may be well illustrated from the chemical course. Our laborato-

ries are the largest and best equipped in the United States; we have a staff of more than twenty teachers in this department; specialization has been carried to an unprecedented extent. Yet we teach fewer methods of technical analysis than many schools far below us in number and in organization, while our instruction in Theoretical Chemistry has been enlarged beyond that offered in any other school of our class, so far as I am informed. The system followed is the result of gradual development, and is thought to have at length attained an unusual degree of thoroughness and completeness. A brief description of it may therefore be of value from a pedagogical standpoint. It will also serve to show that the requirements of a technical school are not in the least incompatible with the preparation of the student for a purely scientific career.

The instruction in fundamental laws of chemical phenomena (usually called " Theoretical Chemistry ") is here not confined to a single lecture-course, but is so arranged as to extend through the whole four-years course of study. In this way two important results are secured. The attention of the student is almost continuously occupied with some part of the subject, involving to a greater or less extent the review of earlier parts, so that a more permanent impression is produced; and, in the second place, the instruction in the general principles of chemistry is thus made to accompany the increase of knowledge of the specific facts, instead of preceding it, as is often the case. During the first year, in connection with the course of lectures on Elementary Inorganic Chemistry, as is usual in such courses, the fundamental laws of chemical combination and their explanation by the atomic theory are discussed at length and exemplified by numerous stochiometrical problems solved by the student. Other theoretical questions — the principle of molecular-weight determinations by Avogadro's hypothesis, the conception of valence, and the periodic law — are also considered. The systematic instruction in Theoretical Chemistry begins, however, in the first term of the second year. In a course of thirty lectures, the principles,

already briefly considered in the first year, are taken up and discussed at length, and many new subjects are introduced. The first few lectures of the course are devoted to a review of the early history of chemistry down to the establishment of the atomic theory, the importance of the fundamental laws of the conservation of matter and of definite and multiple proportions, and their relation to that theory, being emphasized. The later lectures treat of the laws of gases and the hypothesis of Avogadro, its value as a means of determining molecular weights, the methods of determining atomic weights based upon it and on the physical properties of isomorphism and specific heat, the periodic law, the doctrine of valence, and the classification and structure of inorganic compounds. The recent discoveries regarding the nature of solutions and the practical applications of this knowledge to the processes of analytical chemistry are also considered.

It will be noticed that two subjects, stochiometrical calculations and the structure theory of organic compounds, the treatment of which occupies a large part of many text-books and lecture-courses on theoretical chemistry, are, thus far, omitted. This is done because it is thought desirable to teach the general principles of the science in direct connection with the study of the special facts to which they are related, to as great an extent as is practicable. Practice in stochiometrical calculations is appropriately combined with the instruction in quantitative analysis, and the discussion of the structure theory with the work in descriptive organic chemistry. In the third year a second course of lectures treats in great detail of important methods of determining vapor density, and the whole subject of solutions, in which such important discoveries have recently been made, is fully considered. In connection with these lectures, a laboratory course on the methods of molecular-weight determination has been established. Every student is required to obtain accurate results by the three vapor-density methods of Victor Meyer, Hofmann, and Dumas, and by the two solution methods of boiling-point and freezing-point, using the form of appara-

tus devised by Beckmann. The calculations involved constitute no small part of the value of this work.

The laws and theories of Chemistry comprise two distinct subjects: first, the general relations between the properties of bodies and their chemical composition, and second, the laws of chemical change and equilibrium. The latter subject, which has been said to constitute the highest aim of chemical research, and in which we have already attained a very considerable degree of knowledge, is, strange to say, ignored in many courses on theoretical chemistry. This is all the more remarkable since it is pre-eminently that part of the science which is of practical, every-day applicability to specific chemical phenomena. At the Institute the lecture-courses of the second and third years are concerned with the first subject; the second is taken up in the second term of the fourth year. The most important feature of this fourth-year course is an extended discussion of the laws of chemical change and chemical equilibrium, and of their numerous applications. The subjects of thermo and electro chemistry, dealing with the relations between chemical change and heat or electricity, also receive a due share of attention.

A course of laboratory experiments has recently been arranged to accompany these lectures. It includes thermochemical measurements of heats of neutralization and solution, measurement of the electrical conductivity of solutions, of the velocity of reactions, and of the solubility of salts, the last illustrating the principles of chemical equilibrium. The experiments have the double purpose of teaching the practical methods of determining these important data, and of impressing more strongly on the mind of the student the laws considered in the lectures. They are carried out in the new, well-equipped laboratory devoted entirely to Physical Chemistry, of which a description will be given when we consider the development of the Physical Department during the year.

Courses VI. and VIII., Physics and Electrical Engineering. — The resignation of Mr. Collins and the return of Dr. Goodwin

have been mentioned in speaking of the changes among instructors. Otherwise the regular teaching force of the Physical Department remains the same. Professor Holman has, to our great regret, been partly disabled by sickness, and special arrangements have had to be made that the work of instruction might not suffer in consequence. Professor Holman's colleagues have gladly done whatever was required in this direction. The lectures on "Heat" have been given with marked ability by Mr. Clifford, in addition to his regular duties in the department. On account of the death of Mr. A. C. White, for a number of years lecturer on the "Distribution of Electricity for Commercial Purposes," the course was assumed by Assistant Professor Puffer, who will continue to give this instruction. The removal of Mr. J. P. B. Fiske, to take charge of an important manufacturing establishment in Ohio, has necessitated a change in the lectureship on "Electromotors." We are fortunate in securing as his successor Mr. Walter C. Fish (S. B., M. I. T., VI., 1887), the director of the works of the General Electric Company at Lynn.

The embarrassment arising from an excessive number of students in the Physical Laboratory, with insufficient room for their proper accommodation, has become a chronic condition in the department, interfering, especially in Course VI., with the satisfaction fairly earned by the hard work of the corps of instructors. At the same time, the work of the year was successfully accomplished, as a whole. The work of the department is of three classes: (1) Instruction in General Physics, by lectures, recitations, and laboratory exercises given to the students as a whole; (2) Instruction to students in Course VIII., Physics; (3) Instruction to students in Course VI., Electrical Engineering. During the past year there has been carried on a course of recitations in Physics, in connection with the regular second-year lectures. The class (325 in number) has been divided into ten sections, each section reciting twice a week, under the instruction of Mr. Wendell. The results have been satisfactory in the highest degree, not only through diminishing the number of failures in the course

of the year, but also through increasing, in a very marked manner, the general interest in the subject, and the understanding of it attained by the class as a whole.

In the Laboratory of General Physics several changes have been made which it is confidently hoped will carry the instruction to a still higher degree of efficiency. The exact work required of our students necessitates the expenditure of much time, and requires careful individual instruction in order to attain the highest results. Furthermore, it is desirable that more instruction than heretofore shall be given in the details of various special methods of physical measurement. Dr. H. M. Goodwin has been given the immediate charge of all of the work in this laboratory, and besides the regular laboratory practice, will meet the third-year class in the lecture-room, at frequent intervals, for the purpose of discussing methods and instruments of measurement and research. There has also been undertaken a careful revision of the list of required experiments, with the view of arranging more or less distinct series of those having a professional bearing for students of the several courses, so far as is consistent with the general training in accurate physical measurement which it is the primary aim of this laboratory to impart. There are, of course, certain kinds of measurement in which every student, whatever his course, should be carefully instructed; there are others, of a more advanced character, whose particular importance will depend upon the profession which the individual student has in view. It is hoped and expected that such a procedure will lead to more enthusiastic work, and enable the student to appreciate more fully the need of carefulness and accuracy on his part in the various professional laboratories.

In connection with the general work of the department, should be mentioned the course of twenty lectures in Physics, given at the Institute to the students of the Boston Normal School of Gymnastics. These have been in charge of Mr. Louis Derr, and have been successful in all respects. There should also be mentioned the extension of the facilities offered to the students in the Geodetic Option of Course I., who take certain

special professional work in the first term of the fourth year. During the past year some practical experiments in pendulum-measurements were planned and a successful beginning made, through the diligent labor of Mr. Charles Ladd Norton, Assistant in Physics. The limited time devoted to the subject is a bar to any extended work; but the practice cannot fail to be valuable.

The principal addition, however, to our facilities for advanced instruction in pure Physics is the new Physico-Chemical Laboratory. Down to the present time there has been, so far as I am informed, no systematic instruction of this character given in this country. For this purpose, a special laboratory for physico-chemical work has now been fitted up. This laboratory, 28 × 29½ feet, occupies the front part of Room 2, in the southwest corner of the basement. This room is particularly well adapted to physico-chemical work, on account of the dark rooms connected with it. The large dark room will continue to be used for photographic work. The small one, adjacent to it, has been painted white, and will be used for experiments on the electrical conductivity of liquids. Two complete sets of conductivity-apparatus are provided. The third dark room will be devoted to optical work, with the polariscope and Pulfrich refractometer. The regular course will also include thermo-chemical measurements, experiments in chemical dynamics, measurements of small potential differences of voltaic cells, and molecular-weight determinations by Beckmann's boiling and freezing point methods.

The laboratory has been fitted up with every convenience, not only for practical instruction, but also for more advanced research work, which it is hoped will be carried on to no small extent. The course itself is designed primarily to give students practice in the most improved methods now in use in physico-chemical investigation. The laboratory work is taken in connection with a course of lectures on Physical Chemistry, in which the application of the methods to the various problems now attracting the attention of scientists at home and abroad is pointed out.

The importance of this work to students making a special study of Physics and Chemistry can hardly be over-estimated. Within the last few years, science has made such prodigious strides in this direction that a practical as well as theoretical knowledge of this subject is absolutely necessary to an intelligent understanding of physical and chemical literature at the present time. In Germany, particularly, where the greatest advances have been made, the importance of the subject has been recognized by the founding of special chairs of Physical Chemistry at the Universities of Berlin, Leipsic, and Göttingen. The course, as now arranged, will be taken by the third-year physicists and fourth-year chemists. Every opportunity for original investigation is also offered to advanced students who may desire to work in this field.

Still further, in Course VI. there has during the year been a marked movement in the direction of the specialization of courses, referred to in the last President's Report; and also a material advance in the amount and quality of the instruction in electrical measurements and in the study and testing of dynamo-electric machinery. There is much need in the Laboratory of Electrical Engineering of a considerable increase in the plant of dynamo-electric machines. There has never been any installation of such apparatus corresponding, in magnitude and cost, to the experimental engine and the great testing-machine in the Engineering Laboratory. The instruments needed for exact electrical measurement, which are far more essential than anything else, have, indeed, been supplied, to an exceptional extent, from current appropriations; but these are necessarily insufficient for the occasional purchase of large machinery. In connection with the departmental work of Courses VI. and VIII., attention should be called to the great increase in the use of the Physical Library, which has resulted from having a library-assistant constantly in attendance, so that books could be consulted conveniently at all hours of the session. It is proposed to have the Librarian give some instruction to the students as to the manner in which they can use the library to the best advantage.

Course VII., Biology. — There is only one drawback to the steadily increasing usefulness of this department, and that is a most urgent need of room. For ten years the Biological Department has been in one and the same place. Ingenuity, born of necessity, has adjusted and readjusted the allotted space until it has become utterly exhausted. Owing solely to lack of room, Professor Sedgwick is already obliged to repeat the laboratory work in General Biology. Next year, unless space can be had, other exercises will have to be repeated. The waste of energy thus wrought is much to be regretted. The number of registered students, regular and special, receiving instruction, during the present term, in the one room belonging to the Biological Department, is 103. In addition, 24 senior students of the Boston Normal School of Gymnastics are under instruction, making a total of 127. Of these, the number doing laboratory work is 123.

The several classes of the present term are attended as follows: General Biology, 51 students; Comparative Anatomy, 12; Anthropology, 16; Physiology and Hygiene, 5; History of Science, 4; Physiology of the Senses, 4; Microscopic Anatomy, 1; Physiological Laboratory, 2; Theoretical Biology, 5; Comparative Physiology, 28; Bacteriology, 10; Micro-organisms of Fermentation, 20.

The last-mentioned course calls for special notice, as it is not only new to the Institute, but also, it is believed, to the educational institutions of the United States. For the past ten years increasing interest has been felt in the advances making in Denmark in our knowledge of the micro-organisms of various fermentations, such as those of vinegar, milk, brewing, and bread-making. In June last, Mr. S. C. Keith, Jr., Assistant in Biology, went to Copenhagen and entered the well-known laboratory of Alfred Jörgensen, which is devoted to the physiology of the fermentations and especially to the technology of pure yeast-culture. Mr. Keith returned at the beginning of the year, bringing with him a supply of cultures and apparatus. With the consent of the Executive Committee, a circular was issued announcing, as a part of the regular

course in Bacteriology and Micro-organisms, a course of instruction in the Micro-organisms of Fermentation, and offering to a limited number of persons, properly qualified and actually engaged in fermentation industries, an opportunity to familiarize themselves with the latest methods and results of the Danish investigators. The response has been most gratifying. Every place has been taken; and ten persons actually engaged in manufactures depending in whole or in part upon fermentation are now at work in the Biological Laboratory.

Another fact in connection with the Biological Department is worthy of notice. Among the number of special students for the last two years, has been an increasing number of teachers, many of them in actual service in normal, high, or other public schools, or in the private schools of Boston and vicinity. During the present term their number, in this department alone, has risen to 25. It thus appears that the Institute is making a contribution of no small importance toward the teaching of natural science. For several years we have enjoyed the use of an investigator's private laboratory in the Marine Biological Laboratory at Wood's Holl, the gift of Mrs. William B. Rogers. During the season of 1894, this room was occupied, with great advantage, by Dr. Theodore Hough and Dr. R. P. Bigelow.

Course IX., General Studies. — The demand for accommodations for the special use of the General Course has been constantly increasing, until this summer it appeared necessary to fit up Room 44, adjoining the present library, as a study-room. The growing interest in this course is evidenced by the recent organization of a society composed of students and instructors especially related to the course, whose object is to promote its intellectual and social interests. The library facilities of this department are being more generally recognized and utilized by the students at large. In Sociology, Dr. Ripley is preparing a new series of maps based upon the most recent German authorities, for class-room illustration, and will issue a new serial syllabus and bibliography of

Anthropology, Ethnology, and Sociology, for the use of the classes in Social History. It is much to be desired that the financial condition of the Institute were such as to allow a larger appropriation for the purchase of historical books, and also maps, diagrams, and other illustrative material.

Course XII., Geology. — The total membership of the classes taught by the instructors in the department during the past year was 367. In these classes there were 217 different individuals. Mr. Barton now has entire charge of the instruction in Structural Geology given to the students in Courses I., IX., and XI.; and Mr. Grabau is successfully teaching the Palæontology of the third year. In July, a party of nine students, under the leadership of Prof. W. O. Crosby, made a geological excursion to Nova Scotia, devoting two weeks to the study of different interesting localities, and bringing to the Institute a good collection of specimens. The expedition proved highly satisfactory to the members of the party, and they feel that they have been much benefited by the experience obtained. Mr. Henry W. Nichols and Mr. George W. Stose assisted at the Summer School of Topography, Geodesy, and Geology. There have been valuable additions to the collections used in the courses in Economic Geology, in Building Stones, and in Ore Deposits. The palæontological and mineralogical collections have been enriched by useful specimens, and the work of identification and labelling has progressed. There has been a large increase in the notes and syllabuses of courses prepared for the use of students. The demand for graduates of the department to take satisfactory positions has exceeded the supply. Mr. Nichols, who was an assistant last year, and whom we desired to retain on the staff of the Institute, is now in charge of the department of Economic Geology at the Field Columbian Museum in Chicago. Mr. Stose, to whom we offered Mr. Nichols's place, is now engaged on the physiographic work of the United States Geological Survey.

Course XIII., Naval Architecture. — The 28th of May, 1895, will see the first class graduate from the regular four-years

course in Naval Architecture. Experience has shown that the continuous course of lectures, now given twice a week throughout the third and fourth years, accompanied by two or three exercises a week in drawing, give opportunity for presenting the facts and theories of the science of Naval Architecture in a very satisfactory way, and afford the students a considerable degree of facility in applying them. The thorough training in Mathematics, Drawing, and Physics, and especially in Applied Mechanics, which the students in this course share with all other students of engineering, makes it possible to present the work of this particular course in a form which is at once clear and compact. The present fourth-year class in this department has completed even more work than was assigned. The future development of the course must be mainly internal, arranging the work and coordinating it with work given out of the department, so that the students may accomplish the most possible for a given expenditure of time and strength. Such development is unobtrusive, and calls for little comment. The third-year work, which is at once the most elementary and the most vital, has already been reduced to a form that will require only minor changes, and is now given to the students entirely by cyclostyle notes. The work of the fourth year deals with subjects at once more abstruse and, from the lack of positive knowledge, more indefinite. Much of the information regarding them is to be found only in original memoirs or in articles in technical periodicals, while the whole matter is subject to change. The adequate development of this part of the course will require time and labor, and will continue as long as the science grows.

The department has bought two more mechanical integrators, making seven in all; enough for our present needs. It is only by free use of such adjuncts that the work of the drawing-room can be done within the time at our disposal. The library has received many additions in the past year, and now contains nearly all the standard and recent publications of the profession. The department is really in need of

additional space for its proper accommodation. Much of the valuable material already in possession cannot now be properly stored or conveniently used; and much other material could be obtained and used to advantage if we had the room. The drawings and computations are made in the mechanical-engineering drawing-room, upon small tables; and the students have neither the space nor the quiet essential for properly laying down ship-curves and for the use of mechanical integrators.

In Memoriam.

The Institute of Technology has sustained a severe loss in the decease, during the year now closing, of three valued members of the Corporation. Mr. Francis A. Waterhouse, Head Master of the English High School, joined us in 1887. In 1889, on the death of Hon. Charles L. Flint, he became Chairman of the Visiting Committee on the Department of Modern Languages, which position he held to the end, giving most careful attention to the needs of the department, keeping closely in communication with Professor van Daell and his associates, and making frequent and always useful suggestions to them, as well as to the President and Corporation. Mr. Arthur Rotch was a special student of Architecture in the Institute from 1871 to 1873. In 1885, he became a member of the Corporation, and was made Chairman of the Visiting Committee on the Department of Architecture. The high value of his services to the department has already been recognized in the course of this Report. Mr. Rotch maintained to the last his interest in the Institute, and by his will made a substantial addition to the means for carrying on its architectural work.

How shall I speak of our lion-hearted comrade who has just left us? Mr. Henry Saltonstall joined the Corporation in 1885, and became a member of the Executive Committee, May 25, 1887. By a resolution, adopted at your last meeting in October, you warmly expressed your appreciation of

the immense value of Mr. Saltonstall's services to the Institute of Technology. I concur in every word of that testimonial, and for myself desire to add that Mr. Saltonstall's presence on the Executive Committee has been a joy and a strength to me during all these years.

Finances.

The finances of the Institute are such as to demand the most serious consideration of all who are interested in the welfare of the school. The Executive Committee have been able to reduce the annual deficit, which in 1892–93 reached $32,816.75, to $13,603.32 in 1893–94; but such rigid economy could not long be practised without impairing the efficiency and prestige of the school, while the gap between our receipts and expenditures is still far larger than can be contemplated without apprehension. In October of this year, by instruction from the Executive Committee, the President sought and obtained a hearing from the Board of Trustees of the Franklin Fund, consisting of the twelve aldermen of the city, *ex officiis*, and of the pastors of three of the older churches, in which he presented reasons why the Franklin Fund, now between $350,060 and $360,000, should be devoted to the permanent endowment of the Department of Physics and Electricity in the Institute of Technology. That such a use of this very notable and unique fund would form a worthy monument to the great philosopher, whose name has for twenty-six years been carved in stone upon the Rogers Building; that an application of this fund to the promotion of research and instruction in physics and electricity would yield results of great practical, as well as scientific, value; that it would be far better to further endow an institution already existing, and doing successful work, than to attempt to build up a new and separate institution which must always be poor and pinched for means, and regarding whose success there will necessarily be the gravest doubt, — all this appears clear to us; and I am bound to recognize

the great courtesy with which the Board of Trustees listened to the arguments presented. In the probable failure of this effort to enlarge our means of usefulness, and in contemplation of so large and dangerous a deficiency in our finances, the Executive Committee will to-day present to the Corporation a recommendation that the Legislature of the Commonwealth be asked to make annual appropriation of a moderate amount for a brief term of years.

To the Honorable House of Representatives and Senate of Massachusetts, in General Court assembled.

THE UNDERSIGNED, being thereto specially authorized by vote of the Corporation of the Massachusetts Institute of Technology, at a meeting held Dec. 12, 1894, respectfully petition your honorable body that there be granted from the treasury of the Commonwealth for the support and endowment of said Institute the sum of $25,000 per annum, for the term of six years next ensuing.

Your petitioners respectfully represent that the Massachusetts Institute of Technology was incorporated by an Act of the Legislature of Massachusetts, approved April 10, 1861, "for the purpose of instituting and maintaining a Society of Arts, a Museum of Arts, and a School of Industrial Science, and of aiding generally, by suitable means, the advancement, development, and practical application of science, in connection with arts, agriculture, manufactures, and commerce";

That, by the same Act, the Legislature conferred upon the said Institute of Technology the right of perpetual occupancy of two-thirds of the square bounded by Berkeley, Boylston, Clarendon, and Newbury streets, the market price of the land in which an interest was thereby given (restricted to erecting buildings on not more than one-third of the ground), being, according to official appraisement at that time, about $103,000;

That, by an Act approved April 27, 1863, the Massachusetts Institute of Technology was designated as the College of Mechanic Arts for the State of Massachusetts, under the Act of Congress approved July 2, 1862, and in that character and capacity was conceded one-

third of the annual proceeds of the lands granted by the United States to the Commonwealth under the said Act of Congress, the sum accruing to the Institute under this provision being about $5,000 a year;

That the said Institute of Technology, having been duly organized, was opened to students in January, 1865, and has since been conducted as a school of industrial science, with marked and increasing success; that, from the beginning, under its illustrious first president, the Institute of Technology not only afforded sound instruction and training to great numbers of the youth of the Commonwealth, but led in the development of the theory and practice of scientific and technical education, the world over; that in its laboratories of chemistry and physics were first applied methods of teaching which are now used, not only in one hundred scientific and technical schools of the United States, but in every classical college or university of respectable standing, and which are now even being carried down to high schools and academies, to the inexpressible advantage of the cause of education;

That the Legislature of Massachusetts, by acts approved June 16, 1887, and May 23, 1888, granted to the said Institute of Technology the sum of $200,000, payable in four annual instalments of $50,000 each, in view of the pressing financial needs of said Institute, as set forth in a memorial from the Corporation, — the special reason for the grant to the Institute of Technology at that time being found in the extraordinary increase in the number of its students, which, as set forth in the memorial referred to, had risen from 188 in 1878, to 637 in 1886. To-day the number of students in attendance has risen to 1183. One hundred and twenty towns and cities of the State send pupils to the Institute. Every county except Dukes and Nantucket is represented on its lists. There are seventy more students from Massachusetts, alone (707), than constituted the whole body of our scholars at the date of that memorial.

Your petitioners respectfully represent that by an Act of Congress, approved August 30, 1890, a further appropriation was made from the Treasury of the United States for the support of "Colleges of Agriculture and the Mechanic Arts," established by the Act of July 2, 1862, being an annual sum, for the colleges of each State, rising from $15,000, by an annual increase of $1,000, to a maximum of $25,000; that of this new grant, one-third was, by Act of the Legislature ap-

proved June 11, 1891, assigned to the Massachusetts Institute of Technology, as the College of Mechanic Arts for Massachusetts, making the total amount now annually received from the United States, through the State Treasury, under the Acts of 1862 and 1890, about $11,000;

That, during the eight years which have elapsed since the former petition of the Corporation to the Legislature, the expenses of the Institute have, in spite of rigid economy, risen to the annual sum of $295,332.33. Since the last appeal made by the Corporation to the Legislature, it has been necessary to erect two large buildings, at an aggregate cost of $164,473.97, and to purchase land of the value of $356,320.23, for these buildings, and as a provision for the future growth of the institution. Exclusive of all purchases of land, and of the cost of erecting buildings, the aggregate amount which has been expended by the Corporation of the Institute of Technology, in maintaining the school, and in promoting the application of science to the useful arts, since the opening of the Institute in 1865, has been more than three and a half millions of dollars. Including the cost of buildings and of purchased land, the total amount expended by the Institute of Technology has been more than four million six hundred thousand dollars. To this total the contribution of both State and nation combined, has been less than nine per cent.

Your petitioners further represent that, in consequence of the large increase in the number of pupils, and in the current expenses of the Institute, there has been encountered during the past two years an annual deficiency in receipts, as compared with income, of $23,210.03. This financial condition is not only fraught with the gravest danger to the future of the school, but it is at this moment crippling the institution in some measure and weakening the hands of its teachers and administrators.

In explanation of this large increase of expenditures, your petitioners respectfully represent that scientific education is necessarily expensive, requiring the use of costly apparatus and machinery (a single piece, the Emery testing-machine, in use at the Institute of Technology, costing $13,000); that, with every increase of students, it becomes necessary to add expensive instruments; and at all times to maintain an exceptionally high proportion of teachers to pupils. The rapid development of the sciences, especially Chemistry and Electricity, during the past ten years, has made it necessary that

any school which assumes to lead in the development of scientific and technical education, should spend and spare not in its efforts to secure the best and to do the most possible toward that object. The fact that the Institute of Technology is a young institution, surrounded and overshadowed by colleges and universities which have for generations enjoyed a high degree of popular confidence and affection, has made it impossible, in view of the large sums required for current needs, to accumulate, within so short a time, permanent endowments adequate to the scale of its existing operations. Its administrators and friends are, therefore, compelled to appeal to the bounty of the Commonwealth to provide temporarily some part of the means to enable it to continue its work without abatement.

Your petitioners believe that it is not for the interest of the Commonwealth that this school, the first institute of general technology founded in this country, and by far the largest, should be permitted to fail or to suffer from lack of means. When it is remembered that the poor republic of Switzerland has within the past few years expended a sum approaching four millions of francs — $800,000 — in constructing and equipping laboratories of Chemistry and Physics in the Polytechnicum at Zurich, it may fairly be asked whether this rich and powerful Commonwealth, whose wealth and power, not less than its high citizenship, have from the first been peculiarly the fruit of education, should withhold any part of whatever is needed to keep its chief school of industrial science and industrial art in the very forefront of educational progress.

Massachusetts is at the present time passing through a great industrial crisis by reason of the rapidly-increasing competition of the South and West in respect to manufactures traditionally regarded almost as belonging to her, or at least to New England. Without extraordinary efforts for the general education of our people; without further and rapid development of the industrial arts; without a constantly increasing application of the sciences to manufacture, — the sceptre of industrial power is in danger of passing from us. Already manufacturing corporations are asking the Legislature to give them leave to do business outside the Commonwealth; and more are known to be contemplating such a step. Massachusetts, if, in spite of her limited natural advantages, she would keep her supremacy, must do so by the exercise of the same means which first brought her that supremacy; namely, by commanding the highest trained intelligence for the

organization and conduct of her industrial, commercial, and financial enterprises.

In conclusion, it may be added that more than forty-eight per cent of the living graduates of the Institute, and a still larger proportion of former students not graduates, now reside in the Commonwealth, engaged in the advancement of its industries.

FRANCIS A. WALKER, *President.* GEORGE WIGGLESWORTH, *Treasurer.*
AUGUSTUS LOWELL. JOHN CUMMINGS.
THOMAS L. LIVERMORE. A. S. WHEELER.
FRANCIS H. WILLIAMS, *Secretary.*

TREASURER'S REPORT.

STATEMENT OF THE TREASURER.

THE treasurer submits the annual statement of the financial affairs of the Institute for the year ending Sept. 29, 1894.

The financial results of the past year are decidedly more satisfactory than those shown in the statement submitted a year ago. The expenses still exceed the income by a large amount; but that amount, instead of being as last year nearly $33,000, is this year reduced to between $13,000 and $14,000. This is due in part to rigid economy in everything which was not essential to the efficiency of the Institute work; partly, also, to the fact that some of the expenditures of the preceding year were extraordinary ones and did not have to be met this year, and partly to the increase in income due to a larger number of students and to the large bequests received the previous year. There has, also, this year been received a considerable sum as rent for the Clarendon Street property purchased the preceding year. This last item has, however, been largely offset by the expenditure necessary in taking down and altering the northerly end of the building. These alterations we were, by the terms of the original purchase, obliged to make. The large expenditure made in 1893, on account of the Columbian Exhibition, of course did not recur the last year.

In the item of repairs, the saving of about $5,000 was accomplished. This, however, could not have been done, had not the expenditure in previous years been liberal.

In General Expenses there has also been a saving of nearly $3,000.

The income from students' fees has increased over $17,000. In the matter of department supplies there has been an increased expenditure of about $2,000, due to the increased number of students, and the same cause has led to an increase of about $12,000 in the salary account, due to the employment of a larger staff.

The past year has brought to the Institute generous bequests and gifts. By the will of Mrs. Catherine P. Perkins, $88,713 were received by the Institute, and something more is still to be paid it as one of the residuary legatees. Under the will of William J. Walker, $10,537.27 have been received. $868.11 have been added to the Susan E. Dorr fund. From the subscriptions of 1892, have come $24,500 in addition to the previous payments. Besides these, a gift of $200 has been received from Mrs. William B. Rogers, for periodicals; another of $575, from friends, for the mining department and the architectural department, whereby these departments have been enabled to make important additions to their respective collections. A. Lawrence Lowell, Esq., has contributed $500 for the general purposes of the Institute, and the Alumni have added $621 to the William B. Rogers Scholarship Fund.

The net results, after deducting the excess of expenditure over income, and certain other items, is a gain of $105,797.07 to the property of the Institute.

SECURITIES SOLD OR PAID AT MATURITY.
GENERAL FUND.

$2,000	Atchison Gen. Mtg. 4s.	1,351.49	
2,000	Bur. & Missouri River, 6s.	2,000.00	
25,000	Eastern R. R. of Minnesota, 5s.	25,125.00	
13,000	New York & New England 6s.	13,910.00	
1,000	International & Great Northern 6s.	1,164.63	
20,000	United States Consols 4s. 1907	22,950.00	
50,000	Atchison, Topeka, & Santa Fe, 6s.	50,000.00	
65,000	City of Hartford, 4s.	65,650.00	
1,000	Boston United Gas Co. 5s.	807.50	
1,000	Iowa Central 5s.	870.00	
2 shares	Nat. Exchange Bank	231.25	
6 "	State St. Safe Dep. & Trust Co.	615.00	
16 "	Firemen's Fire Ins. Co.	1,943.75	
25 "	Third National Bank	2,193.75	
			188,812.37

SALE OF SECURITIES. WM. B. ROGERS MEMORIAL FUND.

$15,000	Atchison Gen. Mtg. 4s.	12,163.43	
2,000	New York & New England 6s.	2,140.00	
7,000	Chicago, Burlington, & Quincy 7s.	8,286.25	
			22,589.68

RECEIVED SECURITIES. GENERAL FUND.

$20,000	United States Consols 4s. 1907	22,950.00	
1,000	Iowa Central R. R. 5s.	845.00	
1,000	Boston United Gas Co. 5s.	770.00	
2,000	Brookline Gas Lt. Co. 5s.	2,000.00	
2 shares	Dwight Manf. Co.	1,600.00	
1 share	Merrimack Manf. Co.	1,015.00	
1 "	Laconia Co.	605.00	
6 shares	Hamilton Woolen Co.	390.00	
6 "	Manchester Mills	660.00	
2 "	Pepperell Mfg. Co.	2,300.00	
24 "	Everett Mills	2,160.00	
31 "	Great Falls Mfg. Co.	3,472.00	
10 "	Lowell Bleachery	975.00	
27 "	Brookline Gas Lt. Co.	2,700.00	
40 "	Cambridge Gas Lt. Co.	7,000.00	
7 "	Lawrence Gas Co.	882.00	
7 "	Lowell Gas Lt. Co.	1,610.00	
16 "	Firemen's Fire Ins. Co.	1,968.00	
6 "	State St. Safe Deposit & Trust Co.	600.00	
25 "	Atlantic Nat. Bank	2,875.00	
25 "	Nat. Bank of the Republic	3,625.00	
25 "	Third National Bank	2,150.00	
10 "	National Union Bank	1,240.00	
2 "	National Exchange Bank	226.00	
25 "	New England National Bank	3,875.00	
15 "	Merchants' National Bank	2,220.00	

PURCHASE OF SECURITIES. GENERAL FUND.

$35,000	Fitchburg R. R. 5s.	35,700.00	
26,000	Am. Dock and Improvement Co. 5s.	28,860.00	
65,000	City of Hartford 4s.	65,650.00	
65,000	Boston & Maine R. R. 4½s.	66,381.25	
			267,304.25

PURCHASE OF SECURITIES, WM. B. ROGERS MEMORIAL FUND.

24,000	Rome, Watertown & Ogdensburg R. R. 5s.	27,103.75

GEORGE WIGGLESWORTH, TREASURER, *in account with*
GENERAL STATEMENT OF RECEIPTS AND DISBURSEMENTS
Dr.

Cash balance Sept. 30, 1893		12,043.01
From Augustus Lowell for Lowell Courses	5,400.00	
" " " " C. Kastner's salary	2,500.00	
" " " " Lowell School of Design	1,432.00	
		9,332.00
RECEIPTS FOR CURRENT EXPENSES.		
Income of funds for salaries	4,380.00	
" " " " scholarships (students' fees)	4,000.00	
" " " " Joy "	200.00	
" " " " Swett "	400.00	
" " " " Library	250.00	
" " " " general purposes	10,289.12	
" " Rogers Memorial Fund	9,535.72	
Students' fees	212,119.00	
State Agricultural Fund	5,079.50	
State Endowment Fund	6,666.67	
Laboratory supplies and breakages	6,701.37	
Rents, per Table (page 98)	12,273.79	
Gifts	1,275.00	
Contributed by former M. I. T. Students for expenses at World's Columbian Exposition	472.00	
Interest	2,229.97	
Pope Fund for Highway Engineering, used	1,084.06	
Letter-Box Fund $113.50, used of 1893, $74.00	187.50	
Scholarship Fund, used	500.00	
Boston University	1,150.00	
Sale printed Lecture Notes	2,935.31	
Profit and Loss, expenses more than income	13,603.32	
		295,332.33
BEQUESTS FOR SPECIAL PURPOSES, ETC.		
Income James Savage Fund, not used	632.42	
" James H. Mirrlees Fund, " "	8.38	
" Elisha Thacher Loring Fund, " "	41.47	
" Richard Perkins Fund, " "	285.20	
" Charlotte B. Richardson Fund, " "	1,699.23	
" Charles Lewis Flint Fund, " "	37.70	
" Thomas Sherwin Fund, " "	25.00	
" Farnsworth Fund, " "	25.00	
" Pope Fund, " "	115.94	
" W. F. Huntington Fund, " "	35.42	
" Susan Upham Fund, " "	51.87	
" W. B. Rogers Fund (additional $621.00)	813.94	
Susan E. Dorr Fund (income not used)	911.51	
		4,683.08
GIFTS AND BEQUESTS FOR GENERAL PURPOSES.		
Subscriptions of 1892 (additional)	24,500.00	
Catherine P. Perkins Legacy	88,713.00	
William J. Walker Legacy	10,537.27	
		123,750.27
SECURITIES SOLD OR PAID. GENERAL FUND. See List, page 89		188,812.37
SECURITIES SOLD. W. B. ROGERS M. FUND. See List, page 89		22,589.68
SUNDRIES.		
Income General Funds credited to Advance Bond Premium Account	300.00	
Income Wm. B. Rogers Mem. Fund credited to Advance Bond Premium Account	400.00	
Students' Deposits	150.00	
Boston Art Student's Asso. on acct.	666.67	1,516.67
		$658,050.41

MASSACHUSETTS INSTITUTE OF TECHNOLOGY.
FOR THE YEAR ENDING SEPTEMBER 29, 1894.

Cr.

Paid for Lowell Courses	5,400.00	
" " Charles Kastner's salary	2,500.00	
" " Expense Lowell School of Design	1,432.00	
		9,332.00

EXPENSES.

Salaries, per Table (page 98)	200,042.04	
" paid from the Pope Fund	800.00	
Lecturers and Supplies paid from the Pope Fund	284.06	
Scholarships paid from Swett Fund	400.00	
Repairs, per Table (page 99)	7,834.16	
General Expenses, per Table (page 99)	13,485.41	
Fuel	10,916.74	
Water	2,042.90	
Gas	1,812 45	
Printing and Advertising	2,681.67	
" Lecture Notes	3,276.20	
" Annual Catalogue	2,269.43	
Rents paid Boston & Albany R. R. Co.	180.00	
" " Natural History Society	200.00	
Laboratory Supplies and Libraries, per Table (page 12)	32,445.88	
Society of Arts	872.40	
World's Columbian Exposition	450.58	
Interest, 5 per cent on funds not in stocks and bonds	5,711.74	
Interest paid A. Lowell, Trustee	1,000.00	
" " on Mortgage Notes	8,626.67	
		295,332.33

SECURITIES BOUGHT OR RECEIVED AS LEGACIES. GENERAL ACCOUNT.

See List, page 3	267,304.25

PURCHASE OF SECURITIES WM. B. ROGERS MEMORIAL FUND.

24,000 Rome, Watertown & Ogdensburg R. R. 5s.	27,103.75

SUNDRIES.

Letter Box Fund 1893 used	74.00	
Scholarship Fund used	500.00	
Emery Testing Machine	70.56	
Clarendon Street Land and Building	3,060.94	
Boiler House	25.20	
Students' Notes	1,927.50	
Loan to Boston Art Student's Association	15,000.00	
Profit and Loss, per contra. (See page 90)	13,603.32	
		34,261.52
Cash balance, Sept. 29, 1894		24,725.56
		$658,059.41

The following account exhibits the property held by the Institute, as per Treasurer's books, Sept. 29, 1894 : —

INVESTMENT OF THE W. B. ROGERS MEMORIAL FUND.

$50,000.00	Saginaw & Western R. R. 6s. . . .	1913	50,000.00	
30,000.00	Burlington & Mo. River R. R. 4s. .	1910	25,787.50	
27,000.00	Kansas City Belt R. R. 6s.	1916	27,000.00	
16,000.00	Kansas City, Clinton & Springfield R. R. 5s.	1925	16,000.00	
7,000.00	Omaha & Southwestern R. R. 8s. .	1896	7,000.00	
5,400.00	Republican Valley R. R. 6s. . . .	1919	5,400.00	
4,000.00	Cin., Ind., St. Louis & Chicago R. R. 6s.	1920	4,000.00	
2,000.00	Ottawa, Oswego & Fox River R. R. 8s.	1900	2,000.00	
2,000.00	Kansas City, Fort Scott & Gulf R. R. 7s.	1908	2,000.00	
2,760.00	Kansas City, Memphis & Birmingham R. R.			
	920 General Mortgage 4s. . . .	1934		
	1840 Income 5s.	1934		
			2,155.00	
1,000.00	Lincoln & Northwestern R. R. 7s. .	1910	1,000.00	
1,000.00	Atchinson & Nebraska R. R. 7s. .	1908	1,000.00	
42,000.00	Chicago, Burlington & Quincy R. R. Conv. 5s.	1903	40,820.00	
35,000.00	Fort Street Union Depot 4½s. . . .	1941	34,825.00	
24,000.00	Rome, Watertown & Ogdensburg R. R. 5s.	1922	24,000.00	
	Advances to Bond Premium account.		8,571.41	
	Bonds			251,558.91

INVESTMENT OF THE JOY SCHOLARSHIP FUND.

	Massachusetts Hospital Life Insurance Co. .	5,000.00	
	Deposits in Savings Banks	3,555.83	
			8,555.83

INVESTMENT SWETT SCHOLARSHIP FUND.

	Massachusetts Hospital Life Insurance Co.	10,000.00

INVESTMENTS, GENERAL ACCOUNT.

$16,000.00	Bur. & Mo. River (Neb.) R. R. 6s. non-exempt	1918	16,000.00	
6,000.00	Chicago, Burlington & Quincy R. R. 4s.	1922	5.100.00	
3,000.00	Milwaukee & St. Paul R. R. 7 3-10 .	1898	3,000.00	
4,000.00	Chicago, Burlington & Northern R.R. 5s.	1926	4,000.00	
2,000 00	Kansas City, Fort Scott & Gulf R. R. 7s.	1908	2,000.00	
1,000.00	Union Pacific R. R. 6s.	1898	1,000.00	
3,000.00	Hannibal & St. Joseph R. R. 6s. . .	1911	3,000.00	
15,000.00	Chicago, Burlington & Quincy R. R. Conv. 5s.	1903	15,000.00	
6,000.00	West End Street Ry. 5s.	1902	6,000 00	
2,000.00	Brookline Gas Light Co. 5s. . . .	1913	2,000.00	
35,000.00	Fitchburg R. R. 5s.	1903	35,000 00	
65,000.00	Boston & Maine R. R. 4½s.	1944	65,000.00	
26,000.00	Am. Dock & Improvement Co 5s. .	1921	26,000.00	
	Advances to Bond Premium account		5.541.62	
	Bonds			188,641.62
	Amount carried up			$458,756.36

Amount brought up				458,756.36

STOCKS.

SHARES.				
148	Boston & Albany R. R.	par	100	29,933.00
194	Morris & Essex R. R.	"	50	14,690.00
40	New York & Harlem R. R.	"	50	5,000.00
85	Pittsburg, Fort Wayne & C. R. R.	"	100	12,880.00
12	Cocheco Manufacturing Co.	"	500	6,000.00
56	Hamilton Woolen Co.	"	100	5,390.00
59	Everett Mills	"	100	5,310.00
31	Great Falls Manufacturing Co.	"	100	3,472.00
6	Manchester Mills	"	100	660.00
2	Dwight Manufacturing Co.	"	500	1,600.00
1	Merrimack Manufacturing Co.	"	1000	1,015.00
1	Laconia Co.	"	400	605 00
2	Pepperell Manufacturing Co.	"	500	2,300.00
10	Lowell Bleachery	"	100	975.00
27	Essex Co.	"	50	4,050.00
158	Pennsylvania Coal Co.	"	50	23,160.50
15	Consolidated Gas Co., New York	"	100	1,447.50
27	Brookline Gas Light Co.	"	100	2,700.00
7	Lowell Gas Light Co.	"	100	1,610.00
40	Cambridge Gas Light Co.	"	100	7,000.00
7	Lawrence Gas Light Co.	"	100	882.00
55	Old Boston National Bank	"	100	5,510.50
15	Merchants' National Bank	"	100	2,220.00
25	New England National Bank	"	100	3,875.00
25	Atlantic National Bank	"	100	2,875.00
10	National Union Bank	"	100	1,240.00
25	National Bank of the Republic	"	100	3,625.00
				150,025.50

REAL ESTATE.

Rogers Building		315,726.88	
Walker Building		190,492.44	
Land on Garrison Street	50,840.00		
Workshops " "	52,416.49		
		103,256.49	
Land on Trinity Place	76,315.69		
Engineering B'ld'g, Trinity Place	106,616.87		
		182,932.56	
Gymnasium Building		7,967.85	
Architects' Building		57,857.10	
Lot No. 2 Trinity Place		137,241.60	
Clarendon St. Land and Building		142,762.94	
House No. 34 Commonwealth Ave.		30,000.00	
			1,168,237.86
Equipment, Engineering Building		16,555.24	
" Workshops		20,628.56	
			37,183.80
Boiler House			25.20

SUNDRIES.

Notes Receivable	1,500.00	
Boston Art Students' Association	14,333.33	
Emery Testing Machine	10,000.00	
Students' Notes	2,902.50	
Cash Balance, Sept. 29, 1894	24,725.56	
		53,461.39
		$1,867,690.11

The foregoing Property represents the following Funds and Balances, and is answerable for the same.

The income of the following is used for the general purposes of the Institute:

William Barton Rogers Memorial Fund	250,225.00	
Richard Perkins Fund	50,000.00	
George Bucknam Dorr Fund	49,573.47	
Martha Ann Edwards "	30,000.00	
Nathaniel C. Nash "	10,000.00	
Sidney Bartlett "	10,000.00	
Robert E. Rogers "	7,680.77	
Albion K. P. Welch "	5,000.00	
Stanton Blake "	5,000.00	
McGregor "	2,500.00	
General Institute "	36,028.00	
		456,007.24

The income of the following is used towards paying salaries: —

Nathaniel Thayer, for Professorship of Physics	25,000.00	
Jas. Hayward, for Professorship of Engineering	18,800.00	
William P. Mason, " Geology	18,800.00	
Henry B. Rogers, for General Salaries	25,000.00	
		87,600.00

SCHOLARSHIP TRUSTS.

Richard Perkins Fund	52,989.44	
James Savage Fund	13,280.68	
Mrs. Susan H. Swett Fund	10,182.95	
William Barton Rogers Fund	10,202.27	
Joy Fund	8,555.83	
Elisha Thacher Loring Fund	5,370.86	
Charles Lewis Flint Fund	5,291.63	
Thomas Sherwin Fund	5,025.00	
Farnsworth Fund	5,025.00	
James H. Mirrlees Fund	2,675.99	
William F. Huntington Fund	5,243.75	
Susan Upham Fund	1,089.37	
Susan E. Dorr Fund	911.51	
		125,844.28

OTHER TRUSTS.

Charlotte Billings Richardson, Industrial Chemistry Fund,	35,683.79
Charles Lewis Flint, Library Fund	5,000.00
Albert A. Pope, Street Building and Highway Engineering Fund, balance	1,162.07
Letter Box Fund, balance	122.37

MISCELLANEOUS.

Notes Payable	220,000.00	
Students' Deposits	650.00	
Subscription of 1887	123,500.00	
Subscription of 1892	121.250.00	
Martha Ann Edwards Legacy, 1893	98,452.89	
T. O. H. P. Burnham Legacy, 1893	20,000.00	
Catherine P. Perkins Legacy, 1893	88,713.00	
William J. Walker Legacy, 1894	10,537.27	
M. I. T. Stock Account	473,167.20	
		1,156,270.36
		$1,867,690.11

Comparative Statement of Funds, etc.

	Sept. 30, 1893.	Sept. 29, 1894.
Trusts for general purposes	456,007.24	456,007.24
" " Salaries	87,600.00	87,600.00
" " Scholarships	123,476.37	125,844.28
" " Library	5,000.00	5,000.00
Charlotte B. Richardson Ind. Chem. Fund	33,984.56	35,683.79
Albert A. Pope Street Building and Highway Engineering Fund	1,046.13	1,162.07
Letter Box Fund	196.37	122.37
Notes Payable	220,000.00	220,000.00
Student's Deposits	500.00	650.00
Subscription of 1887	123,500.00	123,500.00
" " 1892	96,750.00	121,250.00
Martha Ann Edwards Legacy	98,452.89	98,452.89
T. O. H. P. Burnham Legacy	20,000.00	20,000.00
Catherine P. Perkins Legacy		88,713.00
William J. Walker Legacy		10,537.27
M. I. T. Stock Account	495,379.48	473,167.20
	$1,761,893.04	$1,867,690.11
Increase	105,797.07	
Consisting of: —		
Charlotte B. Richardson Fund Income	1,699.23	
Scholarship Funds, not used	1,378.80	
Subscription of 1892, increase	24,500.00	
A. A. Pope Fund, increase	115.94	
Wm. B. Rogers Fund, additional	621.00	
Catherine P. Perkins Legacy	88,713.00	
William J. Walker Legacy	10,537.27	
Gain on Stocks sold, net	102.25	
Susan E. Dorr Fund	868.11	
Students' Deposits, increase	150.00	
		128,685.60
Less Loss. Expenses more than income	13,603.32	
" on Sale of 20,000 Atchison 4s	3,462.38	
" " Emery Testing Machine, amount charged off	3,923.83	
" " Students' notes, charged off	1,325.00	
" " Scholarship Fund, used	500.00	
" " Letter Box Fund	74.00	
		22,888.53
		$105,797.07

INCOME FROM GENERAL INVESTMENTS, AND APPLICATION THEREOF.

Applied to Salaries	4,380.00	From Dividends, Bank Stocks	599.25
" " Scholarships	4,000.00	" State Tax returned, Old Boston National Bank	71.08
" " Library	250.00	" Bonds	9,583.33
" " General Purposes	10,289.12	" Dividends, Railroad Stocks	2,791.75
" " Increase of Funds	2,970.03	" " Coal and Gas Stocks	2,222.00
" " Advances to Bond Premiums	300.00	" " Manufacturing Stocks	1,210.00
		" Interest allowed on Funds not in Bonds and Stocks @ 5 %	5,711.74
	$22,189.15		$22,189.15

INCOME FROM WILLIAM BARTON ROGERS MEMORIAL FUND, AND APPLICATION THEREOF.

Paid Massachusetts Institute of Technology .	9,535.72	Received Income from Railroad Bonds . . .	9,935.72
Credited to Advances Bond Premiums . . .	400.00		
	$9,935.72		$9,935.72

DETAILS OF SOME ITEMS IN TREASURER'S CASH ACCOUNT.

Rents.

Huntington Hall, for Lowell Lectures		3,500.00	
Lowell School of Design		1,800.00	
Chauncy Hall School, for Gymnasium		500.00	
State Board of Health, for use of Laboratories		712.50	
Boston Water Works, use of Laboratory		200.00	
Land and Building, Clarendon St., 10½ mo. to July 15, and ⅔ tax	5,143.00		
less Taxes 1,152.00			
" Commission 750.00			
	1,902.00		
		3,241.00	
34 Commonwealth Avenue, 1 year	2,200.00		
less Annuity under Will 1,000.00			
less Tax and Repairs 401.83			
	1,401.83		
		798.17	
Use of Rooms and Gymnasium		1,522.12	
			12,273.79

Department Supplies.

Chemistry	9,272.61	
Physics	5,186.40	
Mining	1,816.58	
Mechanical Engineering	2,954.66	
Naval Architecture	127.63	
Applied Mechanics	1,530.93	
Civil Engineering	2,954.00	
Biology	2,239.34	
Geology	889.79	
Architecture	1,147.77	
Drawing	165.25	
Mathematics	98.78	
English	1,003.20	
Workshops	1,393.60	
Modern Languages	185.71	
Periodicals	1,479.63	
		32,445.88

Salaries.

Instruction	165,154.11	
Administration	18,172.24	
Labor	16,715.69	
		$200,042.04

Repairs.

Department Improvements: —			
Chemistry	899.85		
Workshops	696.98		
Physics	536.09		
Biology	315.09		
Mechanical Engineering	241.94		
Architecture	240.99		
Civil Engineering	234.70		
Drawing	207.95		
Mining	106.80		
English	100.86		
Applied Mechanics	75.01		
Geology	58.20		
Military	23.44		
Modern Languages	11.00		
Naval Architecture	6.68		
Mathematics	6.00		
		3,761.58	
Sundries		749.20	
Steam Fitting		611.00	
Walker Building		964.16	
Engineering Building		442.65	
Rogers "		381.56	
Gymnasium "		369.14	
Architectural "		36.44	
Lowell School of Design		214.85	
Boiler, Tools, etc.		256.94	
Ventilation, Huntington Hall		46.64	
			$7,834.16

General Expenses.

Fire Insurance		1,954.08	
Stationery and Office Supplies		1,701.87	
Postage		1,006.00	
Furniture		885.13	
Lowell School of Design		710.57	
Entrance Examinations		662.97	
Washing		564.67	
Plumbing		539.60	
Janitor's Supplies: Brushes, Pails, Soap, etc.		512.94	
Sundries		604.75	
Express Charges, Teaming, etc.		481.63	
Cases, etc., Military Dept.		451.10	
Electric Lighting: —			
Power	266.81		
Wiring, etc.	446.31		
		713.12	
Diplomas, Commissions, and Expense of Drill		386.30	
Gymnasium Supplies, etc.		319.66	
Passage, Clarendon Street to Trinity Place, grading, etc.		255.17	
Amount carried forward		$11,749.56	

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HIS EXCELLENCY GOV. FREDERICK T. GREENHALGE.
HON. WALBRIDGE A. FIELD, *Chief Justice of the Supreme Court.*
HON. FRANK A. HILL, *Secretary of the Board of Education.*

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To the Corporation of the Massachusetts Institute of Technology:

My message to-day is, in general, one of congratulation. In spite of losses deeply felt in the Corporation and Faculty, the work of the school has gone bravely on; new courses of instruction have been instituted, new laboratories equipped, although no buildings have been erected; our numbers have held good, in spite of continued hard times which have told very heavily upon the main body of our students. On the 28th of May last, we added to the list of our alumni one hundred and forty-three graduates bearing the diploma of the Institute, all of them, we believe, well prepared to do their work in life.

Among the events of the year, that which naturally first rises to our minds is the grant bestowed by the Legislature of Massachusetts, in answer to the petition of the Corporation which was authorized at our last annual meeting, and the text of which was appended to the last annual report of the President. Nothing could be more gratifying than the response which came from all parts of the Commonwealth, as soon as it was made known that the usefulness of the Institute was threatened by its straitened financial means. Not only from the eastern counties of the Commonwealth, where the school is best known and from which the larger part of its students are drawn, but from the great central county of Worcester, which has an excellent technical institution of its own, and from the four western counties, came the warmest assurances of sympathy and support. The bill passed both Houses of the Legislature, appropriating twenty-five thousand dollars a year for the term of six years, with a single amendment, cordially accepted by those who represented the Institute in the matter, appropriating in addition two thousand dollars a year during the same term for ten free scholarships

beyond those established under the Acts of 1887 and 1888. The text of the bill will be found appended to the present Report. For this bounty of the State it behooves all friends of the Massachusetts Institute of Technology to be sincerely grateful; and its officers of instruction pledge themselves through me, here and now, that at the end of this term of years the Commonwealth of Massachusetts shall be, not poorer, but richer, for the relief so opportunely afforded to this school of industrial science.

It may be said that an institution like this, after nearly thirty years of active life, ought not to be in such a case, financially, that relief to an amount like that embraced in the Act of April 17, 1895, should be found important, — much more, indispensable. This is true; but it is no fault of those who have guided the destinies of the school or have given instruction within its walls. The fact that the needs of the school were so pressing, at the time of our petition, was wholly due to the resort of students to its halls, directly in consequence of the ever-increasing reputation which had been given to it by the conspicuous success of its graduates in the various industrial professions toward which our training is directed. The petition of the Institute of Technology was not a cry for compassion from an institution that had outlived its usefulness and was slowly decaying from popular neglect, but an appeal for co-operation and assistance in a work in which the Commonwealth is itself deeply interested, and which contributes vitally to the support and development of its industries and its trade. Had the Institute of Technology remained a small college of two hundred and fifty or three hundred students, such as it was fifteen years ago, its means would now be reasonably sufficient for its wants. Its unprecedented growth, multiplying its necessities several fold, has required that much which should have gone to the permanent establishment of the Institute on a broad and enduring basis, be devoted to meeting the immediate and urgent exigencies of successive years. The time has not yet been long enough to create that large body of endowments

which in modern education is required for the proper security and support of an institution of learning of the first class. With our twelve hundred students we ought to have millions of dollars, to render the school independent of temporary fluctuations, to which it is now so painfully subject, and to afford a guarantee that through succeeding generations it shall be found in the fore-front of scientific and technical progress. No other institution of our size but has two, three, or four times the amount of wealth to draw upon which we possess. It has only been exceeding good fortune, combined with extraordinary courage, energy, and self-devotion on the part of its trustees and teachers, that has more than once rescued the school from paralysis, if not from extinction. Is it possible that the means will be long withheld which shall suffice to afford security for the future, as well as the power of continuous improvement and advancement according to our opportunities and to the needs of the great industrial community within which we are placed?

In spite of the fact that more than one hundred colleges and universities in the United States are offering instruction more or less like that which we give, the reputation of the Massachusetts Institute of Technology still suffices to make its diploma a passport to technical employment. I am glad to believe that the reasons for this unusual success of our graduates is due to the character of our instruction, as described by Mr. William Mather, M. P., President of the Association of Technical Institutions in Great Britain. In his annual address delivered in London in February last, Mr. Mather pointed to the Massachusetts Institute of Technology as the best model for scientific and technical schools in his own country, adding these words: "The spirit and energy of the students, their conspicuous practical knowledge, the thoroughness with which their scientific knowledge is tested in the course of instruction, step by step, and the power of adaptation and resource they possess on entering workshops and manufactories, railroads or mines, public works and constructive engineering, — all these fruits of the training of this

Institute are, so far as I have seen, not equalled on the Continent. I think these are the qualities we need in England."

On the 28th of May, I conferred, on behalf of the Faculty and Corporation, the degree of bachelor of science in electrical engineering upon thirty-three young engineers. At the time I handed them their diplomas more than one-half, nearly two-thirds, had secured professional positions. Professor Swain informs me that all his graduates in civil, sanitary, hydraulic, and railroad engineering are in service; and that he has been obliged to decline numerous applications. Professor Richards, in his annual report, states that since the first of September he has had ten applications for men where he has been able to send but two. Professor Sedgwick finds it impossible to keep up with the demand for biologists and bacteriologists. In the chemical department we have frequently been obliged to call upon other institutions for their graduates, as laboratory assistants, in the failure to keep enough of our own to fill the places. I might continue the story, but these statements suffice. While, here and there, by reason of exceptional ill fortune, or from lack of tact and address, a graduate of the Institute of Technology may for a time be out of employment, it remains true that the industries of the United States take up the young men whom we have trained for life as readily as, and even more readily than, they did in the time of our first five or six classes. So far from the supply outrunning the demand, it may be said that the first work of the Institute has, from the beginning, been to create the demand which its graduates should supply. When the school was opened in 1865, there was a moderate demand for civil engineers; for that profession, whose title simply meant that those who bore it were not military engineers, had long enjoyed a certain standing. The profession of mining engineer had also acquired a certain popular repute, mainly through the influence of graduates of European schools. But few, even of intelligent and cultivated people, in 1865 knew what a mechanical engineer was, why he should be called so, or what problems he would be called upon to attack. It was

not until young men began to go out from this and other schools trained as mechanical engineers, that manufacturers, bridge builders, railroad corporations, and persons in a hundred industries who were charged with the generation and use of power, found out that they wanted just such men. In the same way, the American demand for chemists, which, thirty years ago, was supplied by a few graduates from German universities, has been continually expanding until hundreds annually are added to the rolls of that profession. Ten years ago the Institute of Technology opened its course in electrical engineering, the first offered to students in the United States, or possibly in the world. To-day we have in our three upper classes one hundred and twenty-five young men preparing themselves for this service. If, when they come to graduate, they shall find its approaches somewhat crowded by the ill-considered rush of thousands of uneducated or half-trained aspirants, they will with a little patience and persistence learn that there is still "plenty of room in front."

The Graduating Class.

The school year of 1894–95 closed fortunately, on the 28th of May. Of the members of the class, 25 graduated in Civil Engineering, 30 in Mechanical Engineering, 3 in Mining Engineering, 15 in Architecture, 13 in Chemistry, 33 in Electrical Engineering, 2 in Physics, 11 in Chemical Engineering, 4 in Sanitary Engineering, 5 in Naval Architecture, while 4 graduated from the Department of General Studies. These numbers aggregate 145, while yet the graduating class contained but 143. The explanation of this discrepancy brings out the interesting fact that, for the first time in the history of the school, two courses have been completed simultaneously by the same student. This was done in May last, Mr. S. P. Hunt receiving a degree both in Electrical and Chemical Engineering, while Mr. Charles L. Parmalee received a degree both in Civil and in Sanitary Engineering. These gentlemen had entered the Institute with advanced

standing from other colleges. Of the Bachelors of 1894, three — Messrs. Charles Greeley Abbott, Fred Maynard Mann, and Walter Osgood Scott — received the degree of Master of Science, on the completion of an additional year of successful study.

The Entering Class.

The registration of this year, as by the Catalogue now in press, amounts to 1,187 against 1,183 twelve months ago. It appears, therefore, that in the number of students this year the school has held its own.

Year.	No. of Students.	Year.	No. of Students.
1865–66	72	1881–82	302
1866–67	137	1882–83	368
1867–68	167	1883–84	443
1868–69	172	1884–85	579
1869–70	206	1885–86	609
1870–71	224	1886–87	637
1871–72	261	1887–88	720
1872–73	348	1888–89	827
1873–74	276	1889–90	909
1874–75	248	1890–91	937
1875–76	255	1891–92	1,011
1876–77	215	1892–93	1,060
1877–78	194	1893–94	1,157
1878–79	188	1894–95	1,183
1879–80	203	1895–96	1,187
1880–81	253		

Students by Classes.

The aggregate number of students for 1895–96 is divided among the several classes as follows: —

Graduate students, candidates for advanced degrees	4
Regular students, Fourth Year	189
" " Third "	189
" " Second "	197
" " First "	272
Special students	336
Total	1,187

Comparison with the corresponding figures of last year shows that there has been an increase among the regular students in the fourth year of 36; in the third year of 3. There has been a decrease of 1 in the number of candidates for advanced degrees, of 18 in the second year, of 4 in the first year, and of 12 among the special students.

Assigning the special students to classes, according to the predominant studies pursued by them, we reach the following division of the whole body among the several years: —

Class.	Regular.	Special.	Total.
Graduates of the M. I. T., candidates for advanced degrees	4		4
Fourth Year	189	69	258
Third Year	189	100	289
Second Year	197	119	316
First Year	272	48	320
Total	851	336	1,187

Statistics of Examinations.

Of the 1,187 students of the present year, 409 were not connected with the school in 1894–95. Of these, 239 were admitted as regular students of the first year upon the basis of their entrance examinations. The 170 remaining comprise (1) those who had previously been connected with the Institute, and now resumed their places in the school; (2) those who were admitted provisionally without examination; (3) those who were admitted by examination as special students; (4) those who were admitted on the presentation of diplomas or certificates from other institutions of college grade. In addition to the 239 who were thus admitted to the Institute on examination and have taken their place in the school, 61 were admitted on examination, but have not joined the first-year class. This number is precisely that of last year. It has always been remarkable that so many persons should take the trouble of passing the two days' entrance ex-

amination for the Institute, and yet not avail themselves of their right to admission. In brief, this body is made up of (1) those who find themselves so heavily conditioned, as the result of inadequate preparation, that they give up the idea of coming to the school altogether or postpone their entrance with a view to further preparation; (2) those who, having obtained certificates of entrance, use them for securing admission to other colleges, just as we every year receive a considerable number of those who have elsewhere obtained certificates of clear admission; (3) those who are kept away by the ordinary accidents of life, affecting themselves or their families; (4) those who have long desired to come to the Institute, and who, having completed their preparatory courses, perhaps with excellent results, go so far as to present themselves for examination and secure their admission, and are then obliged by poverty to give up their long-cherished plans. Very often, to our knowledge, young men pass their examinations here; but, after trying every means through the summer to secure the necessary funds for beginning their course, are obliged to give up the attempt.

In the case of the 239 persons who were admitted on examination and have joined the school, the results of the examinations, embracing both those of June and those of September, were as follows: —

Admitted clear	175
" on one condition	43
" on two conditions	18
" on more than two conditions	3
	239

Thirty-five applicants were rejected.

Two things may be said regarding these examinations. First, that the results this year, as well as those of last year, show the eminent advantage of the system of preliminary examinations, according to which an applicant is permitted to divide his examination between two successive years. Almost every one who had passed his preliminary examination in June, 1894, was admitted as the result of the final examinations of 1895; while the proportion of conditions among this class of

applicants was very small indeed. Secondly, a very gratifying proportion of those applying for admission, this year and last, took examinations upon more than the subjects actually required. Of the 175 who were admitted "clear," 61 "passed off" some one of the subjects of the first year, generally in mathematics.

Teachers at the Institute.

The attractions of the Institute for teachers who desire to extend their acquirements and to fit themselves for higher work, are continually on the increase. This year we have forty members of that profession registered as students here. When these numbers are considered in connection with the maturity of the pupils and the character of the work done, it will be seen that the Institute of Technology has claims to be regarded as one of the important normal schools of the state. The interest expressed in science-teaching last year was so great that it was decided to offer to teachers studying at the Institute a course of lectures upon that and cognate subjects. This course was given on Saturdays, during the second half-year, from 12 to 1 o'clock, the average attendance being over fifty.

The topics and the lectures were as given below:—

On Certain General Aspects of Teaching and the Teaching Profession. Professor W. T. Sedgwick. (Four Lectures.)

On the Teaching of the Elements of Science. Ellen H. Richards, Instructor in Chemistry.

On the Teaching of Chemistry. Professor Thomas M. Drown.

On the Teaching of Beginners in a Chemical Laboratory. Assistant Professor F. L. Bardwell.

On the Teaching of Beginners in Physics. George V. Wendell, Instructor in Physics.

On the Teaching of Physical Geography. Professor William H. Niles.

On the Teaching of Mathematics. Professor H. W. Tyler.

On the Teaching of Physiology. Dr. Theodore Hough, Instructor in Physiology.

On the Teaching of Zoölogy. DR. R. P. BIGELOW, Instructor in Zoölogy.

On the Teaching of Botany. PROFESSOR W. T. SEDGWICK.

An address on *Epochs in the History of Teaching.* JAMES P. MUNROE, S.B., formerly Secretary of the Institute.

EXAMINATION AT DISTANT POINTS.

In addition to the entrance examinations held at Boston in June and September, examinations were also conducted in June at Buffalo, Chicago, Cincinnati, Cleveland, Denver, Detroit, Easthampton (Mass.), Exeter, (N. H.), Kansas City, Los Angeles, Louisville, New York, Philadelphia, Pittsburgh, Poughkeepsie, St. Paul, Seattle, Washington, and Paris, France.

RESIDENCE OF STUDENTS.

STATES.	Candidates for Advanced Degrees.	Fourth Year.	Third Year.	Second Year.	First Year.	All Regular Students.	Special Students.	Total.
California	..	2	1	1	1	5	3	8
Colorado	..	1	..	1	3	5	2	7
Connecticut	..	5	7	6	4	22	5	27
Delaware	..	1	1	..	2	4	1	5
Dist. of Columbia	..	1	..	3	6	10	6	16
Florida	..	1	..	..	..	1	..	1
Georgia	..	1	..	..	..	1	1	2
Idaho	..	..	..	..	1	1	..	1
Illinois	..	11	9	3	10	33	9	42
Indiana	..	..	..	..	2	2	..	2
Iowa	..	1	1	..	8	10	2	12
Kansas	..	..	..	3	..	3	1	4
Kentucky	..	..	3	2	4	9	2	11
Louisiana	..	2	..	..	..	2	..	2
Maine	1	6	4	7	9	27	11	38
Maryland	..	1	2	..	4	7	2	9
Massachusetts	2	111	115	137	155	520	201	721
Michigan	..	1	..	1	2	4	3	7
Minnesota	..	..	2	..	1	3	2	5
Missouri	..	1	2	..	2	5	4	9
Montana	..	..	1	..	..	1	..	1
Nebraska	..	1	..	..	..	1	1	2
New Hampshire	..	7	4	5	8	24	6	30
New Jersey	..	..	..	3	..	3	2	5
New Mexico	..	1	..	..	..	1	..	1
New York	..	13	11	7	14	45	19	64
Ohio	1	8	6	4	4	23	14	37
Oregon	..	..	..	..	..	..	1	1
Pennsylvania	..	2	8	7	8	25	11	36
Rhode Island	..	3	5	2	6	16	5	21
South Carolina	..	2	1	1	..	4	1	5
Tennessee	..	..	..	..	..	..	1	1
Texas	..	2	..	1	..	3	..	3
Utah	..	..	..	..	1	1	4	5
Vermont	..	..	2	..	3	5	..	5
Virginia	1	..	1	2	4	1	5	
Washington	..	..	..	..	..	..	1	1
West Virginia	..	..	..	..	2	2	1	3
Wisconsin	..	2	..	1	3	6	1	7
Foreign Countries.								
Brazil	..	..	..	..	..	..	1	1
Central-America	..	..	..	..	1	1	..	1
Chile	..	..	..	..	..	..	1	1
Cuba	..	..	..	..	2	2	1	3
England	..	..	..	..	2	2	..	2
Japan	..	..	1	1	..	2	..	2
Mexico	..	..	..	..	..	..	1	1
New Brunswick	..	..	..	..	1	1	..	1
New So. Wales	..	1	..	..	..	1	..	1
Nova Scotia	..	..	1	..	..	1	1	2
Ontario	..	..	2	..	..	2	..	2
Porto Rico	..	..	..	..	..	..	1	1
Quebec	..	..	..	..	..	..	2	2
Spain	..	..	..	..	..	..	1	1
Turkey	..	..	..	..	1	1	2	3
Venezuela	..	..	..	..	..	..	1	1
Total	4	189	189	197	272	851	336	1187

Thirty-seven States of the Union, beside the District of Columbia and the Territory of New Mexico, are represented on our list of students. Of the total number of 1,187, 721 are from Massachusetts, or 60.7 per cent of the whole; 121 are from other New England States; 345 are from outside New England. Of these, 25 are from foreign countries.

A table showing the number of students in each year, from and including 1889, coming from each State or Territory and from each foreign country, may not be without interest and instruction: —

States.	1889.	1890.	1891.	1892.	1893.	1894.	1895.
Alabama	1	..	2	4	2	1	..
Arkansas	2	3	3	2	1	..	..
California	10	14	19	14	15	9	8
Colorado	6	4	7	7	5	8	7
Connecticut	36	31	30	27	30	29	27
Delaware	..	1	..	2	4	3	5
Dist. of Columbia	9	7	4	4	7	12	16
Florida	2	3	3	4	3	2	1
Georgia	1	2	2	3	3	2	2
Idaho	..	..	1	1	1	..	1
Illinois	33	34	32	40	39	36	42
Indiana	3	6	3	5	6	3	2
Iowa	4	9	10	10	13	10	12
Kansas	..	2	2	1	1	4	4
Kentucky	4	4	8	7	11	12	11
Louisiana	4	8	5	2	3	3	2
Maine	30	29	27	39	36	38	38
Maryland	4	7	7	6	4	4	9
Massachusetts	533	517	565	603	665	707	721
Michigan	13	16	13	10	7	8	7
Minnesota	10	12	13	13	11	9	5
Missouri	8	8	12	13	17	14	9
Montana	..	1	..	..	2	2	1
Nebraska	1	1	1	4	3	4	2
Nevada	..	1	3	3	2	2	..
New Hampshire	21	23	24	29	32	27	30
New Jersey	13	11	16	11	6	5	5
New Mexico	..	..	1	2	2	1	1
New York	25	40	40	50	52	59	64
North Carolina	2	1	1	1	..	..	..
Ohio	35	33	33	39	45	50	37
Oregon	2	1	1	2	1	1	1
Pennsylvania	23	22	26	25	31	37	36
Rhode Island	22	21	26	24	33	25	21
South Carolina	1	2	4	1	3	3	5
South Dakota	1	..	..	..	..	..	..
Tennessee	5	3	4	1	1	1	1
Texas	..	1	2	5	6	6	3
Utah	..	..	..	1	2	2	5
Vermont	4	4	5	4	5	3	5
Virginia	6	5	6	4	3	2	5
Washington	2	2	3	3		3	1
West Virginia	2	2	2	2	1	1	3
Wisconsin	9	10	7	5	11	6	7
Foreign Countries.							
Argentine Rep.	..	2	..	..	..	..	..
Belgium	..	..	..	1	1	1	..
Brazil	2	2	4	..	..	1	1
Bulgaria	1	1	1	1	1	..	..
Central America	..	..	1	1	1	..	1
Chile	..	..	..	..	..	1	1
Colombia	1	..	2	..	..	..	..
Cuba	..	..	..	..	1	1	3
England	..	2	1	1	1	..	2
France	1	1	1	1	1	..	..
Germany	..	..	..	..	2	1	..
Guatemala	1	..	..	1	..	..	..
Hawaiian Islands	1	4	4	2	2	..	..
Holland	..	..	2	2	2	2	..
Ireland	1	1	..	..	1	1	..
Japan	1	4	3	1	1	1	2
Mexico	1	1	1	1	1	1	1
New Brunswick	1	1	2	1	1	1	1
New South Wales	..	..	1	1	1	1	1
Nova Scotia	2	2	1	..	..	1	2
Ontario	1	1	2	2	4	4	2
Peru	1	3	1	..	..	..	..
Porto Rico	2	2	1	..	1	1	1
Quebec	1	4	4	5	5	2	2
Scotland	1	3	2	1	2	1	..
Spain	..	..	..	1	1	1	1
Trinidad	1	1	1	..	..	..	..
Turkey	2	1	2	1	..	1	3
Venezuela	..	.	1	..	1	1	1
Total	909	937	1,011	1,060	1,157	1,183	1,187

Residence of Massachusetts Students.

It has been said that 60.7 per cent of our students are from Massachusetts. All the counties of the State, except Dukes and Nantucket, send students to the Institute. One hundred and thirty-two cities and towns are borne on the lists, eight more than last year. The first column of the following table shows the number of cities and towns in each county sending pupils; the second column gives the aggregate number from each county. It appears that Middlesex sends two hundred and sixteen, and Suffolk two hundred and fifteen pupils; Essex comes third, with ninety-two; Norfolk, fourth, with sixty-seven. This is the first time since these statistics began to be compiled that Middlesex County has equalled Suffolk in the number of students at the Institute of Technology.

County.	No. of Towns.	No. of Students.	County.	No. of Towns.	No. of Students.
Barnstable . . .	6	10	Hampshire . . .	5	6
Berkshire . . .	4	13	Middlesex . . .	35	216
Bristol	7	27	Norfolk	18	67
Essex	20	92	Plymouth . . .	11	29
Franklin . . .	3	4	Suffolk	4	215
Hampden . . .	7	15	Worcester . . .	12	27
			Total	132	721

The following is a list of the towns, thirty-eight in number, which send four or more students to the Institute: —

Boston . . .	205	Waltham . .	9	Natick . . .	6
Newton . .	38	Lawrence . .	8	Pittsfield . .	6
Cambridge .	30	Plymouth . .	8	Quincy . . .	6
Brookline . .	22	Brockton . .	7	Reading . .	6
Somerville .	22	Chelsea . .	7	Concord . .	5
Newburyport	20	Framingham .	7	Fitchburg . .	5
Lynn . . .	18	Gloucester .	7	Barnstable .	4
Hyde Park .	16	Medford . .	7	Belmont . .	4
Lowell . . .	14	Springfield .	7	Danvers . .	4
Malden . .	10	Taunton . .	7	Mansfield . .	4
New Bedford	10	Watertown .	7	Milton . . .	4
Salem . . .	10	Arlington . .	6	Woburn . .	4
Melrose . .	9	Haverhill . .	6		

The following table exhibits for ten years the distribution of the total number of students among two classes: first, those students whose names are found upon the Catalogue of the year preceding; and secondly, those whose names appear upon the Catalogue of the year to which the statement relates.

Year.	(1) Total No. of Students.	(2) No. of Students in the Catalogue of the previous year who remain in the Institute.	(3) No. of New Students entering before issue of Catalogue.	(4) Of those in column (3) the following number are regular first-year Students.	(5) No. of New Students not of the regular first-year class.
1886–87	637	379	258	190	68
1887–88	720	396	324	229	95
1888–89	827	465	362	245	117
1889–90	909	557	352	255	97
1890–91	837	572	365	234	131
1891–92	1,011	624	387	258	129
1892–93	1,060	618	442	303	139
1893–94	1,157	701	456	301	155
1894–95	1,183	768	415	271	144
1895–96	1,187	778	409	266	143

Ages of Students on Entrance.

The next table exhibits the ages of our students upon entrance, after taking out those who are repeating the first

Period of Life.	1894–5.		1895–6.	
	Half-year Groups.	Yearly Groups.	Half-year Groups.	Yearly Groups.
16 to 16½ years . . .	2	—	5	—
16½ to 17 " . . .	10	12	4	9
17 to 17½ " . . .	20	—	28	—
17½ to 18 " . . .	27	47	23	51
18 to 18½ " . . .	45	—	38	—
18½ to 19 " . . .	67	112	49	87
19 to 19½ " . . .	37	—	42	—
19½ to 20 " . . .	23	60	23	65
20 to 20½ " . . .	16	—	19	—
20½ to 21 " . . .	5	21	16	35
21 to 22 " . . .	18	18	11	11
	270	270	258	258

year, and ten of unusual ages. These deductions leave two hundred and fifty-eight as the number of students whose ages have been made the subject of computation. The results appear in the following table in comparison with the corresponding results of 1894–95.

From the foregoing, it appears that the average age on entrance is eighteen years and ten months.

In this connection I present the ages, at graduation, of the class leaving us in May. The one hundred and forty-three members of the class were distributed among the different periods of life as follows: —

Between 20 and 20½	2
" 20½ " 21	9
" 21 " 21½	20
" 21½ " 22	25
" 22 " 23	34
" 23 " 24	21
" 24 and over	32
Total	143

Proportion of Regular and of Special Students.

The following table exhibits both the absolute number of regular and of special students, as by the Catalogue of each successive year since 1882, and the proportion existing between these two classes: —

Year.	No. of Regular Students.	No. of Special Students.	Total No. of Students.	Percentage.	
				Regular.	Special.
1882–83	219	149	368	60	40
1883–84	272	171	443	61	39
1884–85	368	211	579	64	36
1885–86	415	194	609	68	32
1886–87	442	195	637	69	31
1887–88	520	200	720	72	28
1888–89	590	237	827	71	29
1889–90	652	257	909	72	28
1890–91	658	279	937	70	30
1891–92	706	305	1,011	70	30
1892–93	774	286	1,060	73	27
1893–94	823	334	1,157	71	29
1894–95	835	348	1,183	71	29
1895–96	851	336	1,187	72	28

Women as Students at the Institute.

The number of women pursuing courses with us is seventy-five, as against fifty-eight last year. Of these, nine are graduates of colleges. Of the total number, seven are regular students of the fourth year; three of the second year; four of the first year. Sixty-one are special students. Of the ten regular students of the upper classes, five take Course IV., Architecture; two, Course V., Chemistry; one, Course VII., Biology; one, Course VIII., Physics; one, Course XII., Geology. Of the special students, twelve devote themselves to Chemistry; two to Physics; thirty-eight chiefly to Biology and allied subjects; five to Geology; one to Architecture; two to English, History, or Political Science; one to first-year subjects.

Graduates of Other Colleges.

The number of students who are graduates from this and other institutions is eighty. Of these, thirteen are our own graduates, of whom four are pursuing studies as candidates for advanced degrees; sixty-nine (including two who are also graduates of the Institute) are graduates of other institutions, pursuing courses of study with us, either as regular or as special students. Eleven are graduates of Harvard University; five of Smith College; four of Williams College; three, each, of Amherst College, Brown University, and the Sheffield Scientific School of Yale; two, each, of Maine State College, College of New Jersey (Princeton), Dartmouth College, and Yale University; while the following institutions are represented on our list by a single graduate each: Universities of California, Chicago, Oregon, Santiago, Venezuela, Vermont; Columbian, Cornell, Drake, Johns Hopkins, Northwestern, Wesleyan, Iowa and Louisiana State Universities; Colorado, Cumberland, Carreras, Central Turkey, Charleston, Dickinson, Hampden-Sidney, Haverford, Mt. Union, St. Johns, Spanish National, Trinity, Wooster, Iowa State Agricultural

Colleges, Massachusetts College of Pharmacy, Royal Military College, United States Military Academy, United States Naval Academy, Worcester Polytechnic Institute.

The graduates of the Institute who are candidates for advanced degrees are Messrs. Charles William Berry, the holder of the Swett fellowship, in Physics, now studying abroad; Frank Augustus Bourne, in Architecture; Herbert William Chamberlain, the holder of the Savage scholarship, in Architecture; and George Defren, in Chemistry. Of the seventy-six graduate students not candidates for advanced degrees, forty are regular students, — viz., eighteen in the fourth year; fifteen in the third; five in the second; two in the first. Of the thirty-eight graduates who are regular students in the three upper classes, eight take Civil Engineering; two, Mining Engineering; four, Mechanical Engineering; nine, Architecture; two, Chemistry; eleven, Electrical Engineering; and two, Chemical Engineering.

The Courses of Instruction.

The following table presents the numbers of the regular students in the second, third, and fourth years, by courses.

Year.	Civil Engineering.	Mechanical Engineering.	Mining Engineering and Metallurgy.	Architecture.	Chemistry.	Electrical Engineering.	Biology.	Physics.	General Course.	Chemical Engineering.	Sanitary Engineering.	Geology.	Naval Architecture.	Total.
4th Year Class	27	32	11	22	15	50	3	4	6	6	4	3	6	189
3d " "	28	38	7	17	20	45	2	4	5	11	4	..	8	189
2d " "	33	48	7	28	24	31	2	3	3	8	2	..	8	197
Total . .	88	118	25	67	59	126	7	11	14	25	10	3	22	575

The following table shows the figures of the total line in the foregoing table, in comparison with the corresponding figures for the next ten preceding years: —

Year.	Civil Engineering.	Mechanical Engineering.	Mining Engineering and Metallurgy.	Architecture.	Chemistry.	Electrical Engineering.	Biology.	Physics.	General Course.	Chemical Engineering.	Sanitary Engineering.	Geology.	Naval Architecture.	Total.
1885 . . .	44	74	26	10	23	41	4	1	5	..	..	..	..	228
1886 . . .	45	75	19	13	24	52	4	2	8	..	..	..	..	242
1887 . . .	50	89	16	18	23	61	5	6	14	..	..	..	..	282
1888 . . .	71	100	12	21	28	74	4	5	12	11	..	..	..	338
1889 . . .	79	99	14	30	29	91	9	5	12	14	6	..	..	388
1890 . . .	79	95	18	27	27	105	11	4	13	18	7	3	..	407
1891 . . .	81	104	17	33	23	108	11	5	19	28	9	3	..	441
1892 . . .	76	106	19	37	35	112	9	5	16	34	5	3	..	457
1893 . . .	78	97	22	50	39	141	4	10	19	31	10	2	8	511
1894 . . .	88	111	19	48	50	137	5	9	19	35	13	2	20	556*
1895 . . .	88	118	25	67	59	126	7	11	14	25	10	3	22	575

* Counted twice, two.

It will appear from the foregoing table that the course in Electrical Engineering remains the largest of the courses of the school. The courses in Mechanical and Civil Engineering follow in the order in which I name them. These three courses together embrace three hundred and thirty-two of the five hundred and seventy-five regular students, candidates for the degree, in the three upper classes. Of all the large courses, No. IV., Architecture, shows the greatest proportional increase of regular students; viz., from forty-eight to sixty-seven. This is the result of continuous efforts on the part of the Faculty, and especially of Professor Chandler, to place the Architectural course on as broad and systematic a foundation as any other in the school. This course will always, however, embrace a considerable number of college graduates and of young men who have had experience as draughtsmen and assistants in architects' offices, who are allowed to enter the department as special students, to get as nearly as possible what they require, without passing through the full course. The Chemical and Biological courses also contain considerable numbers of special students, often of advanced grade, some of them teachers or persons who have been engaged in professional practice.

The following table exhibits the number of persons who have graduated within each of the several courses at each succeeding year since the first diplomas were conferred: —

Year.	Civil Engineering.	Mechanical Engineering.	Mining Engineering.	Architecture.	Chemistry.	Metallurgy.	Electrical Engineering.	Natural History or Biology.	Physics.	General Course.	Chemical Engineering.	Sanitary Engineering.	Geology.	Naval Architecture.	Total.
1868	6	1	6	..	..	..	..	..	..	1	..	..	..	..	14
1869	2	2	..	..	1	..	..	..	..	..	..	..	..	..	5
1870	4	2	2	..	1	..	..	..	..	1	..	..	..	..	10
1871	8	2	5	..	2	..	..	..	..	..	..	..	..	..	17
1872	3	1	5	..	3	..	..	..	..	..	..	..	..	..	12
1873	12	2	3	1	7	..	..	..	..	1	..	..	..	..	26
1874	10	4	1	1	..	..	..	..	..	2	..	..	..	..	18
1875	10	6	6	1	1	..	..	..	1	2	..	..	..	..	27
1876	12	9	7	..	5	1	..	2	3	4	..	..	..	..	43
1877	12	6	8	4	2	..	..	..	..	..	..	..	..	..	32
1878	8	2	2	3	3	..	..	..	..	1	..	..	..	..	19
1879	6	8	3	1	3	..	..	1	1	..	..	..	..	..	23
1880	3	..	3	..	1	..	..	..	..	1	..	..	..	..	8
1881	3	5	6	3	8	..	..	1	..	2	..	..	..	..	28
1882	2	5	5	3	6	..	..	1	1	1	..	..	..	..	24
1883	3	7	5	1	3	..	..	..	..	..	..	..	..	..	19
1884	5	6	13	..	12	..	..	..	..	..	..	..	..	..	36
1885	4	6	8	2	4	..	2	..	..	1	..	..	..	..	27
1886	9	23	7	1	7	..	10	1	..	1	..	..	..	..	59
1887	10	17	8	1	9	..	8	1	1	3	..	..	..	..	58
1888	11	25	4	5	10	..	17	3	1	1	..	..	..	..	77
1889	15	23	5	3	8	..	17	1	1	2	..	..	..	..	75
1890	25	27	3	5	13	..	18	3	2	6	..	..	..	..	102
1891	17	26	4	6	11	..	23	3	3	1	7	..	1	..	102
1892	22	26	4	13	7	..	36	6	1	7	4	6	1	..	133
1893	25	30	5	2	8	..	41	2	..	6	8	..	2	..	129
1894	21	31	4	13	11	..	33	1	3	5	12	3	..	..	137
1895	25	30	3	15	13	..	33	..	2	4	11	4	..	5	145*
Total	293	332	135	84	159	1	238	26	20	53	42	13	4	5	1,405
Deduct names counted twice															11
Net total															1,394

* Counted twice, two.

The following table shows, by classes and by courses, the number of regular students who have registered themselves as electing to distribute the required studies and exercises over the period of five years.

Year.	Total.	Course.												
		I.	II.	III.	IV.	V.	VI.	VII.	VIII.	IX.	X.	XI.	XII.	XIII.
1st . .	4	..	..	..	..	..	..	..	..	..	..	..	..	..
2d . .	5	2	..	..	1	1	..	..	..	..	..	..	..	1
3d . .	11	..	1	1	1	1	5	..	..	1	..	..	..	1
4th . .	5	..	..	..	..	..	3	..	1	..	..	..	..	1
5th . .	10	..	4	1	1	..	2	..	..	..	..	..	2	..
	35	2	5	2	3	2	10	..	1	1	..	..	2	3

Classification of Special Students.

Our special students can, of course, not be classified systematically; but the following table exhibits the number of such students pursuing each particular branch of study:—

Applied Mechanics . . .	64	Language	157
Architecture	42	Mathematics	174
Biology	64	Mechanical Engineering .	62
Chemistry	129	Mining Engineering. . .	9
Civil Engineering . . .	40	Naval Architecture . . .	2
Drawing	135	Physics	158
Electrical Engineering. .	22	Political Science	62
English	105	Shopwork	57
Geology	47	Sanitary Engineering . .	5
History	84		

The following is the number of students, either regular or special, pursuing certain leading branches of study, in each of the four years, as follows:—

	First Year.	Second Year.	Third Year.	Fourth Year.	Total.
Mathematics . . .	324	272	206	79	881
Chemistry	348	62	79	48	537
English	291	247	18	13	569
French	197	79	40	18	334
Physics	..	284	274	141	699
German	73	174	163	10	420
Shopwork	12	118	45	39	214

Changes in the Faculty and the Corps of Instruction.

The most important change in the Faculty during the year on which I am now reporting, has been the resignation of Professor Drown, upon his appointment to the presidency of another institution. The history of the Institute of Technology is full of painful losses which it has sustained for the enrichment of other institutions. Harvard, Yale, Columbia, and now Lehigh, have in succession carried away from us some of our most valued instructors.

Professor Drown came to the Institute in 1885, having formerly been Professor of Mining Engineering in Lafayette College, Pa., and having served for twelve years as secretary of the American Institute of Mining Engineers. At the time of his appointment in the Institute of Technology, we congratulated ourselves very heartily upon the acquisition of so ripe a scholar and so experienced a teacher; we had yet to learn the full extent of our good fortune. For ten years Dr. Drown has been our Professor of Analytical Chemistry, and for five years has been at the head of the entire chemical department, with its large staff, its extensive laboratories, and its hundreds of pupils. His success in this important and difficult charge has been remarkable. Perfect harmony has existed. The considerable business of the department has been conducted with efficiency; the whole body of students have felt the influence of a calm spirit, a strong will, a clear intelligence, and a genial disposition, steadying, strengthening, and inspiring them in their work.

The chemical investigation into the potable waters of Massachusetts, which Professor Drown has carried on since 1887 on behalf of the State Board of Health, during which time fifteen thousand seven hundred complete analyses of water have been made in the laboratory under his direction, has not only increased Dr. Drown's scientific reputation, but has added prestige to the Institute. His mapping of the "Normal Chlorine" of the several regions of the Commonwealth con-

stitutes one of the most important of recent contributions to sanitary chemistry. As a member of the Faculty, Professor Drown's services to the Institute can never be adequately acknowledged. His unvarying courtesy, conciliatory disposition, and sympathetic feeling were admirably united to strength of purpose, clear thinking, and firm decision. Dr. Drown carries to his new field of labor the affectionate remembrance and hearty good wishes of all his late colleagues at the Institute of Technology.

The following named assistant professors have been advanced to the grade of associate professor: Messrs. Pope, Currier, Homer, Dippold, and Talbot. Deserved promotion has been given to six instructors: Messrs. Lodge, Woodbridge, and Clifford, Drs. Woods, Ripley, and Hough, who have been advanced to the grade of assistant professor.

Mr. Lodge was a student of Course III. in the class of 1879. During the school year 1879–80, he was assistant in the mining laboratory. Leaving the Institute, he went into professional practice, being engaged in mining, at first in Colorado, and afterward as superintendent of a silver mine in Nevada. From 1883 to 1885 he was head chemist of the North Chicago Rolling Mills, and was afterward connected with the South Chicago Works. In 1887 he became chemist of the Sloss Iron and Steel Company, of Birmingham, Alabama. In 1889 he returned to the Institute as Instructor in Mining Engineering and Metallurgy.

Mr. Woodbridge graduated from Williams College in 1873, and subsequently received his degree of Master of Arts from the same institution. In 1874 he came to the Institute of Technology as a student, and in 1883 became Instructor in Physics. Gradually he developed so high an interest in the special subject of warming and ventilating buildings that his work became more and more directed upon the scientific principles involved and the technical means to be used in controlling the temperature and the movement of air. When the Walker Building was erected in 1883, Mr. Woodbridge designed and supervised the very extensive sys-

tem through which that building has come to be known to many scientific men as the best ventilated public building in the world; the air in nearly all the rooms of the building being insensibly changed once in eleven minutes, while the air of the two great chemical laboratories is renewed every seven minutes. When the Engineering Building was erected in 1889, and again in 1892 when the Architectural Building was erected, Mr. Woodbridge acted gratuitously as the expert adviser and superintending engineer of the ventilating systems of these buildings. Gradually his work at the Institute has become more and more specialized; and new courses in heating and ventilating have been developed for the benefit of the engineers, the architects, and finally of the naval architects. Meanwhile Mr. Woodbridge has been entrusted with arrangements for the warming and ventilation of many of the most important buildings, including the Massachusetts State House Extension, the new State Houses of Maine and Rhode Island, the Boston Subway; and, finally, at the last session of Congress, he was appointed to study and report upon the ventilation of the Capitol at Washington. It is in recognition of the highly scientific character of Mr. Woodbridge's work in exact research that he has been promoted to be Assistant Professor of Heating and Ventilation.

Dr. Woods graduated at Wesleyan University in 1885, received the degree of A. M. for a year of graduate study, and during a few years following was engaged in teaching. In January, 1890, he came to the Institute to fill the place of one of our mathematical instructors who was leaving at that time. He remained at the Institute until May, 1891, when he went abroad to pursue his mathematical studies in Germany, and took his degree of Ph. D. at Göttingen in 1894. Last year he returned to the Institute as an instructor. At the opening of the present year he was appointed Assistant Professor of Mathematics.

Mr. Clifford graduated from the Institute of Technology, Course VI., in 1886, and was at once made Assistant in Physics. In 1888 he was appointed instructor, and the pres-

ent year has been promoted to the grade of Assistant Professor of Theoretical Physics.

Dr. Hough graduated at Johns Hopkins University. After three years spent in teaching in secondary schools, he returned to Johns Hopkins, and for four years pursued graduate studies in biology, obtaining his doctorate in 1893. He was for one year a junior assistant in physiology, and held the fellowship in animal physiology from 1892 to 1893. Dr. Hough came to the Institute as Instructor in Biology in the fall of the year last named.

Dr. Ripley graduated from the Institute course in Civil Engineering in 1890. Turning his attention to studies in economics, statistics, and sociology, he obtained a fellowship in Columbia College, where he took his degree of Ph. D. in 1892, with distinction. He at once returned to the Institute of Technology, becoming Instructor in Economics and Statistics, holding also a lectureship in Columbia, which, however, calls for only a small portion of his time. While assisting Dr. Dewey in the Department of Economics and Statistics, Dr. Ripley has developed courses in Sociology which have already attained a high educational value.

The fact that, of the six instructors thus introduced into the Faculty, three received the bachelor's degree from other institutions, while four have received higher degrees, fairly represents the effort which is making, not only to give our instruction a highly educational value, irrespective of technical accomplishments and acquirements, but also to secure liberality and breadth of character by bringing in men who represent the training and culture of other institutions. It may be interesting to the Corporation to learn that, of the present instructing staff, ten received their bachelor's degrees, whether in arts or in science or in philosophy, at Harvard College; two in the Lawrence Scientific School; four received their bachelor's degree from the Sheffield Scientific School; four from Amherst College; three from Johns Hopkins University; two from Bowdoin College; and one each from Boston University, Columbia College,

Iowa State College, Wesleyan University, Williams College, University of Virginia, U. S. Military Academy, Lafayette College, University of Illinois, University of Vermont, Pennsylvania State College, University of Minnesota, New Hampshire College of Agriculture and the Mechanic Arts. Six received their first degrees in arts or in science at foreign colleges or universities. In all, twenty-five other colleges and universities are represented by forty-four graduates on the instructing staff of the Institute. In addition to the foregoing, nine of our own graduates, now engaged in the work of instruction here, have taken higher degrees at other institutions, chiefly abroad, so that it may be said that fifty-three of our instructors have had an experience extending to graduation in some university or college beside the Institute, and that the training and culture of twenty-nine institutions of the higher learning are represented on our lists.

No appointment has been made of a successor to Dr. Drown. Professor Crafts, to whom the Corporation would, with great satisfaction, commit the charge of the entire Chemical Department, entertains the feeling that he can be more useful to the Institute by confining himself to his work in organic chemistry. Nevertheless, Professor Crafts has allowed the President to confer freely with him regarding the interests of the department as a whole; and has been at much pains — which are here gratefully acknowledged — to prevent the loss of Dr. Drown from being too painfully felt. Dr. Talbot has, at the request of the Executive Committee, undertaken to conduct the business of the Chemical Department, the purchase and distribution of supplies, the accounts, etc., for all the laboratories. Otherwise, the department has been without a single responsible head, as for the past five years under Dr. Drown; and the several professors and instructors have reported directly to the President, who has done whatever he could to strengthen their hands, and furnish the means for carrying on their work to the best effect. It is, perhaps, not to be regretted that for a year, at any rate,

this added responsibility should be thrown upon the gentlemen in charge of the several laboratories and of the different branches of the chemical service of the Institute.

Among Instructors the following changes have occurred during the year: —

Dr. Samuel P. Mulliken has been appointed Instructor in Organic Chemistry. Dr. Mulliken graduated from the Institute, with the class of 1887, in the Department of Chemistry. He was Assistant in Chemistry in the University of Cincinnati, 1887–88. He then went to Germany for advanced study, taking his doctor's degree at Leipsic in 1890. He was Fellow in Chemistry at Clark University, 1890–91; Associate in Chemistry at Bryn Mawr, 1891–92; Instructor in Organic Chemistry at Clark University, 1892–94; Research Assistant with Dr. Wolcott Gibbs at Newport, 1894–95.

Justus Erhardt, the newly appointed Instructor in Modern Languages, graduated at the Istituto Technico of Bologna in 1888, and has since then been engaged in teaching.

Henry Fay and George W. Rolfe have been appointed Instructors in Analytical Chemistry. Dr. Fay graduated at Lafayette College in 1889, received the degree of A. M. from the same institution in 1892, and attained the doctorate at Johns Hopkins University in 1895. In the intervals of academic work, Dr. Fay has been engaged in professional practice. Mr. Rolfe graduated at Harvard College in 1885, and took his A. M. degree there in 1886. Since that time he has been engaged in professional practice at the West, and on sugar plantations in Cuba, with the exception of one year spent in teaching.

Henry E. Crampton, Jr., appointed Instructor in Biology, graduated from Columbia College in 1893, and was, for two years following, Assistant in Biology in that institution.

Harry W. Gardner, appointed Instructor in Architecture, graduated at the Institute, with the class of 1894, from the Department of Architecture, and passed the intervening year in professional practice.

The following Assistants have been appointed Instructors:

L. Kimball Russell, S. B., in General Chemistry; F. Jewett Moore, Ph. D., in Analytical Chemistry; Charles L. Norton, S. B., in Physics; Simeon C. Keith, Jr., S. B., in Biology; Frederick H. Keyes, S. B., in Mechanical Engineering; Kilburn S. Sweet, S. B., in Civil Engineering; Ervin Kenison, S. B., in Mechanical Drawing; W. Felton Brown, in Free-hand Drawing. Messrs. Norton, Keith, Keyes, Kenison, and Sweet graduated from the Institute in 1893. Mr. Russell graduated in 1886. Dr. Moore graduated from Amherst College in 1889; was assistant in Chemistry in that institution in 1889–90; student at Heidelberg, 1890–93, taking his doctor's degree in the latter year; instructor at Cornell University, 1893–94. He came to the Institute of Technology last year as Assistant in Chemistry. Mr. Brown comes to us from the École des Beaux Arts, Paris, where he studied for four years under the best masters.

The following named Instructors have resigned their work at the Institute: Dr. Thomas Evans, Organic Chemistry; Mr. Herbert R. Moody, Analytical Chemistry; Mr. Charles M. Faunce, Mechanical Drawing and Descriptive Geometry; Mr. Robert S. Shedd, Architecture. These gentlemen resigned their positions to enter professional practice, except Mr. Shedd and Mr. Faunce, who, I deeply regret to say, were compelled to leave the Institute by reason of ill health. Mr. Shedd was a student at the Institute in the "partial course" in architecture, 1888–90; was Assistant in Architecture, 1892–94; and was appointed Instructor in the latter year.

The following gentlemen have been appointed Assistants: Samuel C. Prescott, S. B., in Biology; Franklin H. Robbins, S. B., in Mechanical Drawing; Harold K. Barrows, S. B., in Civil Engineering; James F. Norris, Ph.D., in Organic Chemistry; Walter S. Williams, S. B., in Industrial Chemistry; Charles A. Meserve, S. B., in Sanitary Chemistry; Frederick W. Howe, S. B., and Charles R. Walker, S. B., in General Chemistry; William J. Drisko, S. B., and Henry A. Holdrege, S. B., in Physics; Alexander Moseley, S. B., Jesse H. Bourne, S. B., Carl H. Clark, S. B., and Fred A. Hannah, S. B., in Me-

chanical Engineering; Ira G. Studley, in Machine Tool Work. All of these are graduates of the Institute, and of the class of 1895, except Dr. Norris, who took his doctor's degree last summer from Johns Hopkins University, Mr. Howe, who graduated from the New Hampshire College of Agriculture and the Mechanic Arts, class of 1894, and has had one year of professional practice, Mr. Moseley, who graduated from the Institute in 1891, and has since been engaged in practice, but has now decided to adopt teaching as his profession, Messrs. Prescott and Robbins, who were of the Institute class of 1894, and Mr. Studley, who was a special student with us in shopwork only.

The following Assistants have terminated their connection with the Institute to enter professional practice: Barron P. Du Bois, S. B., William W. Crosby, S. B., Frank D. Richardson, S. B., and Thomas G. Richards, S. B., in Mechanical Engineering; Edward M. Hunt, S. B., in Civil Engineering; Leslie R. Moore, S. B., in Industrial Chemistry; Walter E. Piper, S. B., in General Chemistry; and Edward P. Hutchinson, in Machine Tool Work.

Statistics of the Corps of Instructors.

The Catalogue of 1895–96 shows the number of instructors of all grades to be one hundred and twenty-one, inclusive of those concerned with the mechanic arts, but exclusive of those who are announced as lecturers for the year only. The addition of these raises the total to one hundred and forty-seven. The following table shows the distribution among the several classes of instructors, in comparison with last year: —

	1894–95	1895–96
Professors	20	19
Associate Professors	5	10
Assistant Professors	17	18
Instructors	52	53
Assistants	21	21
Lecturers	22	26
Total	137	147

The instructing staff for the year 1895–96 is distributed as follows among the several departments of the school: —

	Civil Engineering.	Mechanical Eng. and App. Mechanics.	Mining Engineering and Metallurgy.	Naval Architecture.	Architecture.	Chemistry.	Physics and Electrical Engineering.	Biology, Zoölogy, Etc.	Mineralogy, Geology, and Geography.	English, History, and Political Science.	Language.	Mathematics.	Drawing and Descriptive Geometry.	Military Tactics.	Mechanic Arts.
Professors . . . . (19)	1	1	1	1	2	1	2	1	1	2	1	4	..	1	..
Associate Professors (10)	3	1	1	..	1	2	..	..	..	1	1	..	..	..	..
Assistant Professors (18)	..	3	1	..	..	3	3	1	1	1	1	3	1	..	..
Instructors . . . . (53)	4	6	..	1	2	11	6	3	1	3	4	4	5	..	3
Assistants . . . . (21)	2	6	..	..	..	6	2	1	..	..	..	..	1	..	3
Total . . . (121)	10	17	3	2	5	23	13	6	3	7	7	11	7	1	6
Lecturers . . . . (26)	1	..	1	..	5	6	12	1	..	..	..	..	..	..	..
Total . . . (147)	11	17	4	2	10	29	25	7	3	7	7	11	7	1	6

At the annual meeting of the American Association of Agricultural Colleges and Experiment Stations, held this year in Denver, we were so fortunate as to be represented by our colleague, Hon. Frank A. Hill, Secretary of the Massachusetts State Board of Education. The Association is steadily making progress in the discussion of the problems which confront the scientific and technical schools of the country.

At the invitation of the management of the Massachusetts Charitable Mechanics' Association, with which the Institute of Technology has maintained special relations ever since its organization, an exhibit of our work and methods was entered at the Triennial Fair of the Association, beginning October 1. That at a very slight expense the exhibit of the Institute was made at once so pleasing and instructive, was wholly due to the

energy and good taste of Professor Merrill, of the Department of Mechanical Engineering, who kindly undertook the task. We were also invited to make an exhibit at the Atlanta Exposition; but the great cost of the representation of our work at Chicago served to deter the Executive Committee from undertaking an enterprise so formidable as a general exhibition of the organization and work of the school. Through the kind offices of Professor Sedgwick, however, who visited Atlanta as one of the jury of awards, a number of students' drawings, and several large illustrated volumes showing precisely the course of instruction in our main departments, were neatly installed at a slight expense.

The Manufacturers' Mutual Fire Insurance Company has presented to the Institute a machine for determining the coefficient of friction; and Mr. Edward Atkinson has given a pyrometer, with reference to undertaking certain important special investigations.

Mr. Thomas Gaffield, of this city, has presented to the Institute his collections relating to the manufacture of glass. Mr. Gaffield has long been known as an authority on this subject, and his collection of materials has extended over many years. His gift comprises a considerable library, containing the literature of the subject, as well as large and varied collections, chemical, mineralogical, metallurgical, and mechanical. The library contains two hundred and sixty-one volumes dealing with glass and kindred subjects. These include a number of old treatises which are of great interest in the history of the subject. There are also six volumes on precious stones. Mr. Gaffield has been especially interested in the effects of light upon glass; and the library contains thirty-four volumes having reference to this subject. Perhaps the most generally interesting and valuable part of the collection is composed of sixty-three volumes on the manufacture and history of works of art in glass and in porcelain. Many of these are beautifully illustrated with colored plates, and are of high value. Especially worthy of mention are two large folios, Delange et Borneman, "Recueil de Faïences Italiennes de

XV., XVI., XVII. siècles," 1889, and Warrington, "History of Stained Glass," 1848; also Deville, "Histoire de l'art de verrerie," 1873; Fortnum, "Maiolica in South Kensington Museum," 1873; and Jacquemart, "Histoire de la Céramique," 1875. The works just mentioned, and others of great artistic merit, will be placed in the library of the Department of Architecture.

On the practical side, Mr. Gaffield's collection includes sets of glass-workers' tools, models of furnaces and glass pots, samples of materials used in glass-making, samples of glass-blowers' work, specimens of old cathedral glass, and of mirror, ground, and plate glass. There are, also, several hundred specimens which show the results of Mr. Gaffield's study of the varying action of sunlight upon different sorts of glass. Besides the above are specimens showing the action of sand-blast, of glue and mucilage, and of hydrofluoric acid. A special case has been constructed to display this collection in the Department of Chemistry. In addition to these gifts to the library and to the chemical department. Mr. Gaffield has presented to the Department of Geology a valuable collection of minerals.

The Library.

In addition to the heavy loss sustained by the school in the resignation of Professor Drown, the Institute has lost its accomplished librarian, Mr. Clement W. Andrews, whose work in promoting the growth of our library and in arranging our unusually large collection of scientific works and periodicals, has brought him the deserved honor of appointment to the chief librarianship of the new Crerar Library of Chicago, which, it is understood, will be entirely devoted to the literature of science. While all who have known his unstinted service to the Institute must feel regret at the loss of an officer so valuable and so efficient, the Faculty did not withhold their congratulations to Mr. Andrews upon his advancement to one of the highest positions in his profession. Mr. Andrews' work at the Institute has been all that could be desired; and

he will long be gratefully remembered by those with whom he has been associated here. The choice of a successor to Mr. Andrews was not an easy one. Merely an accomplished man, trained in modern library methods, would not answer all our requirements. A special knowledge of scientific and technical literature, and a thorough appreciation of the work of the school in all that is peculiar and characteristic of it, are essential to the proper conduct of that office. While our library does not rank with the great libraries in respect to the number of volumes, yet there are few anywhere which approach in completeness its scientific collections, and especially its periodical literature in technology. In the last respect the library is pre-eminent, receiving, in one or another department of the school, five hundred and three periodicals, exclusive of annuals. After careful consideration, the Executive Committee offered the position of librarian to Dr. Robert P. Bigelow, Instructor in the Department of Biology. Dr. Bigelow, after some hesitation at the sacrifice of professional study involved, accepted the position, and assumed charge of the office on the first of September. He also succeeds Mr. Andrews as Secretary of the Society of Arts, and Editor of the Technology Quarterly.

The total accessions to the libraries of the Institute during the year are as follows:

By purchase	1,583
" gift	2,198
" binding	626
Total accessions	4,407

The net accessions of volumes and of pamphlets in each department is exhibited in the following table, together with the total number of volumes and pamphlets in each library.

The practice of receiving books for inspection, having been found to be of great advantage, has been continued, and space in the bookcases has been found for the display of these new books. The total number received for inspection during the year is 253, of which 133 were purchased and the remainder returned to the dealers sending them.

Net Accessions.

Library.	Volumes added.	Pamphlets added.	Total* Volumes.	Total† Pamphlets.
General { Mathematics, Modern Languages, Military Science }	418	267	4,232	2,835
Engineering and Naval Architecture	626	342	6,050	2,702
Mining	136	37	1,518	275
Architectural	265	33	1,647	171
Chemical	424	76	6,229	1,386
Biological	56	54	1,668	331
Physical	437	46	4,798	632
Political Science	593	450	7,357	2,837
English	176	1	2,014	36
Geological	53	106	1,573	704
Margaret Cheney Room	6	1	568	13
Total	3,190	1,413	37,654	11,922

* Including volumes of bound pamphlets.
† Including pamphlets bound together in volumes, and maps and diagrams.

The total number of orders for the purchase of books given during the year is 1,406. Duplicate orders to the number of 98 were received by the librarian from heads of departments; 39 of these were accepted, and the rest returned to the departments. Of those returned, only 12 were reordered. The number of cards added to the main catalogue is 3,132, making the total number in the catalogue 34,871. For every card added to this catalogue a duplicate card has to be added to the catalogue of the department to which the book belongs, and frequently an additional reference card is sent to the catalogue of an allied department, so that during the year

there have probably been written altogether 6,400 catalogue cards. The accuracy with which the books have been recorded is shown by the fact that Mr. Andrews, in comparing the catalogue and old order-slips, while making out his lists for the Crerar Library, found less than twenty errors in our catalogue of nearly thirty-five thousand cards.

The Institute has been fortunate during the year in the receipt of a large number of gifts to the library, many of which are worthy of special mention:

From Mrs. William B. Rogers we have received 6 volumes.

From Dr. Henry P. Quincy, 8 volumes.

From the American Book Co., 16 volumes.

From Professor Cross, 19 volumes.

From Professor Drown 55 volumes, including 18 volumes of the American Journal of Science, 14 volumes of the Engineering and Mining Journal, and 5 volumes of Monatshefte der Chemie, 1880-1884, first edition.

The Institute has received by bequest, from the library of the late Arthur Rotch, 84 volumes of architectural books, many of them of very great value.

The largest contribution from a single person is from Mrs. Henry Draper, who has presented to the Institute during the past year 235 volumes, chiefly on architecture, all valuable and many of them rare. Among these are a complete set of Ruskin's Works, Édition de Luxe, 26 volumes; Wicar, Tableaux, bas-reliefs et camées de la Galerie de Florence, 4 volumes, large folio, 1789–1803; Paris, Académie des Sciences, Comptes Rendus, 26 volumes; Penot and Chipiez, History of Art; San Marco in Venezia, 12 volumes of plates and 2 of text; Palustre, La Renaissance en France, 3 volumes; Letarouilly, Le Vatican, 2 volumes; and Conder, Landscape Gardening in Japan, 2 volumes.

Summer Schools in the Field.

Mining Engineering and Metallurgy. — As the members of the Corporation know, the summer school of mining engineering and the summer school of metallurgy are carried on in alternate years. This was the metallurgical year. Professor Hofman took charge of the school, and conducted a party of five to various works in New Jersey and Pennsylvania. When an establishment was visited, each student made careful observations of certain portions of the process, which had been assigned to him. Later in the day all the members of the school held a session and compared results, writing up complete notes of the process, each one contributing his share. The works thus studied were those of the Orford Copper Company, Balback Smelting and Refining Company, Passaic Zinc Company, the Benjamin Atha and Illingworth Company, the Lackawanna Iron and Steel Company, the North Lebanon Furnaces, the Cornwall ore banks, the Coleman Iron Company, the Pennsylvania Bolt and Nut Company, the Pennsylvania Steel Company, the Everett Furnaces, the Broad Top Coal Field, the Cambria Iron Company, which comprise a variety of iron and steel works, as well as copper, zinc, lead, and silver smelting works, and also some coal mines. The proprietors of these works received the students most hospitably, and in a very generous way permitted them freely to inspect and study their operations.

Geodesy, Topography, and Hydraulic Engineering. — The summer school for field work in geodesy, topography, and hydraulics was held during the month of June at Keeseville, N. Y., the location being the same as that for the summer schools of 1893 and 1894. Twenty students from the third-year class were in attendance. The work was conducted by Professors Burton and Porter, and Mr. Robbins, of the Civil Engineering Department. In addition, Mr. George C. Whipple, of the class of '89, and Mr. S. H. Thorndike, of the class of '95, both graduates in Civil Engineering, were engaged for special instruction. The plane-table survey of the surrounding

country was extended so as to embrace a total area of seven square miles, the area covered in this year's work being more than equal to that of the two previous years put together. The base line and all the angles in the system of triangulation were re-measured this year. In the base line measurement the temperature of the 100-meter steel tape was determined for the first time by means of the thermophone, an instrument recently invented by Mr. Whipple and Mr. H. E. Warren, the latter a graduate in Electrical Engineering. The thermophone used was one which had been especially devised for this work, and calibrated for the steel tape used, and the results attained were satisfactory in the highest degree. Another use of the thermophone was made at the summer school, in the determination of the temperature of the water of Lake Champlain at different depths. The temperatures were taken at points in the lake where the water was 250 or more feet in depth. A steam-launch was used in this work, and an apparatus was especially devised for taking these deep soundings with rapidity and accuracy. The greatest depth found was 396 feet. The instruction in the use of the thermophone was given by Mr. Whipple. Tables and diagrams illustrating these experiments will soon be published in full in the "Technology Quarterly." In addition to the above work, a true meridian line was established and permanently marked, and observations for time and latitude were taken. The hydraulic field work was not essentially different from that of last year. Measurements of the discharge of the Au Sable River and of the mill-flumes in Keeseville were made with floats and meters, the meters being rated on Augur Lake. Owing to the absence of instructors of the Geological Department, there was no field work in geology this year. In other respects, the work was very complete and successful.

Architecture. — The summer school of architecture was held this year, as last, at Salem; and the special subject chosen for consideration was colonial architecture, of which so many choice and beautiful examples are to be found in that city and the immediate vicinity. The kindness with which the

class, comprising seventeen students, was received by the people of Salem cannot be adequately acknowledged. The Essex Institute gave the use of Plummer Hall as a headquarters for the class and for evening drawing. Several of the choicest residences of the city opened their doors day after day to students, who were permitted to make studies and measured drawings of hallways, stair-cases, mantelpieces, and old furniture. The hospitality, in many forms, offered to this class of Institute students was far beyond what could have been asked or expected.

Summer Courses at the Institute.

In the President's Report of December, 1894, reference was made to the fact that a limited amount of instruction in the laboratories and lecture-rooms of the Institute, by members of the instructing staff, had been introduced tentatively during the vacation of that year. The results of the experiment were found sufficiently satisfactory to justify the offering of a somewhat larger number of courses during the summer of 1895. While the attendance was not so large as was expected, it is believed that enough good was accomplished to repay the time and effort of the instructors in charge. The committee of the Faculty, under the chairmanship of Professor Crafts, which arranged for the holding of these courses during the summer, has, since the opening of the new academic year, been carefully studying the results, with a view to making recommendations as to whether the system shall be continued and be made permanent, and if so, as to the best methods to be pursued. The experiment is an interesting one and well worthy of consideration. As was stated last year, the summer classes have the character of private instruction, and are conducted without expense to the Institute. While receiving the Faculty's sanction, they are carried on without supervision or assumption of responsibility on the part of the Faculty. The subjects treated in these courses are Mathematics, General Chemistry, Analyt-

ical Chemistry, Organic Analysis and Organic Preparations, Physics and Physical Measurements, Biology, Bacteriology, Drawing, Descriptive Geometry, Orders of Architecture, Architectural Design, French, and German. Most of the courses announced were taken by a sufficient number of students to compensate the instructors for their time and labor. It will require at least another year to determine the question whether there is a real and permanent demand for such a system.

The classes of students for whose benefit this summer instruction was originally designed were four. First, those who, on coming to the Institute, may desire to obtain advanced standing. For a single example, a graduate of a classical college coming to the Institute to study architecture or engineering, may, during the five or six weeks occupied by the courses in mechanical drawing, take the entire first-year work in that subject. Second, those who may desire to make-up "conditions" under the instruction of trained teachers, rather than through their undirected study at home. Third, those of our own students who may desire to anticipate some of the work of the coming year, either as a means of enabling them to take additional studies, or laboratory or field work, or in order to make their work lighter during term time. Fourth, still another class in contemplation in organizing these summer courses were those persons, especially teachers, living in the vicinity of Boston, who may desire to obtain the advantage of a limited amount of work within the laboratories and lecture-rooms of the Institute. It was the supposed needs of the four classes just pointed out which caused the Faculty, two years ago, to authorize those instructors who desired to do so to undertake this enterprise and offer instruction in the rooms of the Institute. As I said, the experiment has had a certain degree of success, without any drawbacks. It will require at least another year to ascertain whether there is enough in these summer courses to justify their being accepted as a permanent part of our system. Should this be so, it will become a question worthy

of our consideration whether the whole care and charge of the instruction should be assumed by the Institute.

During the present term the Faculty have adopted two new rules, affecting both the school day and the school year. These changes are believed to be of a nature to promote the successful conduct of our work and to minister to the convenience of our students. Let me first speak of the change in the school day. Heretofore the rule has been to open at 9 o'clock. Class exercises were continued until 1, when a recess was taken until 2.15, at which time exercises were resumed for two additional hours, the school day closing at 4.15. It will thus be seen that the school day consisted of six hours of possible recitation or laboratory work. The recent development of our curriculum has made the traditional arrangement seem wasteful and inconvenient, and the Faculty have accordingly adopted a rule by which the school day begins as heretofore at 9 o'clock and continues until 5, with regular one-hour periods. On Saturday, school exercises cease at 1. It thus appears that there are now, on ordinary days, eight hours of possible laboratory, or drawing or class-room work. There are, however, no more recitations or exercises on this account, the whole effect of the change being to give a greater freedom in the assignment of hours and a better use of the laboratories, drawing-rooms, and recitation-rooms. But, while there are thus eight hours of possible school exercises, it is provided that the hour, 1 to 2, shall be used only for those few and generally small classes which cannot otherwise find a place in the tabular view. Secondly, it is provided that no student shall have exercises during both the noon-hours; that is, from 12 to 1, and from 1 to 2. The keeping open of the laboratories and drawing-rooms until 5 o'clock is a change long desired by our students.

In regard to the school year, the change has been in the nature of lengthening it by some days, in order to allow a better arrangement for the Christmas vacation, and also to secure an intermission in the second half of the year. It is provided that the school year shall begin on the first Wednes-

day after September 25; that the Christmas vacation shall consist of the first half, or the last half, of Christmas week, according as Christmas Day shall fall within the former or within the latter period; and that there shall be an intermission of the same duration, and bearing the same relation to April 19th, now a holiday under the law of the State. The number of actual school days during the school year remaining unchanged, the effect of the new rules is to cause the school to begin two days later and to close one week later, than heretofore.

Military Department. — Captain Bigelow has conducted the Military Department of the Institute during the year with eminent success. He has made this course of instruction thoroughly respected by the students, and has infused a spirit of promptitude, attention, and diligence such as never before pervaded the department. The difficult question of excuse from drill on various accounts has been treated with excellent judgment, with the result that the number of excuses has been unprecedentedly small. The most important changes in this branch of instruction during the year have been the discontinuance of the practice of drilling one-half the class at a time, and the abandonment of the two-battalion system. The corps of cadets is now organized as a single battalion with four companies.

The regular theoretical and practical examinations held at the beginning of the present school year, with a view to the selection of officers for the battalion, open to all first-year students, were attended by forty-eight members of the class of 1899, representing twenty-five different schools. The statistics of these examinations may not be without interest as bearing on the relative success in military instruction attained by the High Schools of Boston and Massachusetts, compared with those of other sections. Four Boston schools were represented by twelve students, who attained an average mark of 7.3 on a scale of 12. Thirteen schools of Massachusetts outside of Boston were represented by twenty-seven students, who attained an average of 7.5. From the East, outside

of Massachusetts, and from the South, appeared four students, representing three schools, who attained an average mark of 8.2. From the West five students presented themselves, representing five schools. These attained an average mark of 8.4. To compare Massachusetts with other states in this respect, we have seventeen of our schools represented by thirty-nine students, at these examinations, who attained an average mark of 7.4. From the other states came nine students, representing eight schools, who attained an average mark of 8.3. Captain Bigelow has also collected information regarding the previous military training of all the students of the first-year class except three. It appears that 125 had such previous experience; while 134 never drilled before coming to the Institute. Of the 125 having had previous experience, 43 served as field, staff, or company officers; 27, as non-commissioned officers; 55, as privates. Of the same 125, 27 had military training through one year or less; 26, through a second year or a part thereof; 36, through a third year or a part thereof; 36, through more than three years. The total number of students taking drill is 262. Eight have been excused on account of disability and take the theoretical course in military science, making the total in this department 270.

Courses I. and XI. — Civil and Sanitary Engineering. — Few changes of importance have been made in the courses of study. The transfer of integral calculus to the second year has rendered it possible to move forward into the third year the applied mechanics hitherto given in the fourth year, so that the course in mechanics follows that in physics without any interval, and is given in one year, instead of being distributed over two. The time left free in the fourth year has not yet been definitely assigned to other work, since this time will not become available until 1897–98. In the Geodetic Option, the time given to physical laboratory work has been increased, while that given to bridges has been diminished, this change being in the line of greater specialization. There are no students taking this option the present year. Of the thirty-one students taking most of the studies of the fourth

year, twenty-two are taking the first or General Option, while nine are taking the Railroad Option. While it is not expected that any large number of students will ever elect to follow the Geodetic Option, owing to the relatively small number of opportunities for young men in this line of work, and the tendency of our students to follow the more distinctly practical studies in preference to the more purely scientific ones, it is yet highly desirable that we should be in a position to offer the best in this line of engineering as well as in others. Few studies afford a better training in logical reasoning, in analysis, and in careful numerical computation, than geodesy and astronomy; and the young man who does good work in these lines will be apt to succeed in other branches. I would therefore again urge the desirability of our having a separate small building, on firm ground, in the country, suitable for the special work of this option, equipped with the necessary instruments. The transit instrument used in the alignment of the Hoosac Tunnel has been so reconstructed and modified during the past year that it serves now as an excellent astronomical transit and zenith telescope, and is amply sufficient for our needs. This instrument, while available for field work, cannot, however, be satisfactorily used in our course of instruction at the Institute until a firmer foundation can be built for it than is consistent with the situation of the present buildings. The expenditure of about one thousand dollars for the separate building, and the additional instruments alluded to, would enable us to meet all possible needs in this direction for some time to come.

In connection with the development of the geodetic work, reference should again be made to the fact that at the summer school the ingenious new instrument, the thermophone, recently invented by two of our graduates, was applied for the first time in determining the temperature of the steel tape used in measuring the base-line. This interesting application of the instrument has been already noticed in the account of the summer school. It may be well to call attention to the fact, that since this department has given special attention to

the development of the work in geodesy, it has made several distinct and original contributions to the science. First came the improved apparatus for the measurement of base lines with the steel tape, developed in 1891 by Messrs. Bradley and Campbell; then came the use of electricity in measuring the exact average temperature of the tape and so determining its precise length; and lastly, comes the application of the thermophone to this same problem. Professor Burton is at present preparing a paper describing this work in detail, and giving the results attained at our various summer schools.

As a further assistance in the geodetic and topographical work, Professor Burton was authorized to expend a considerable sum of money, during his summer abroad, in the purchase of a collection of modern topographical maps on large scales, of the different countries of Europe, which will be used in connection with the lectures on cartography in the course in topographical drawing. These charts have been selected with reference to the illustration of the best methods of topographical representation, and make a collection almost unique, and probably unsurpassed in the country. In addition to the thermophone, a level-trier has been added to the instrument equipment, for testing the accuracy of level bubbles.

In the Course in Sanitary Engineering, a new subject of instruction, hydraulic machinery has been introduced in the second term of the fourth year. The hydraulic equipment of the department has been increased by the purchase of two new current meters, a Fteley meter, similar to the one already in use, and a Price acoustic meter, the latest type of hand instrument. We now have five meters, in addition to the Darcy-Ritter tube. This addition to the number of instruments has been rendered necessary, not only by the increase in the number of students in this department, but by the fact that students in three other courses receive instruction in hydraulic field-work. Measurements have been made this fall at Lowell, in the Boott and Merrimac flumes, through the courtesy of the Proprietors of Locks and Canals. In the hydraulic labor-

atory valuable experiments were made in determining coefficients for the new weir (mentioned in my last report), and in investigating the loss of head at diaphragms. No large pieces of apparatus have been installed since my last report, but some additions are contemplated during the coming year.

During the past year, in addition to the regular instruction in the department, special lecturers were engaged as follows: Mr. H. G. Prout, Editor of the "Railroad Gazette," on Steel Rails; General Roy Stone, Chief of the Department of Road Inquiry, at Washington, on Highway Legislation; Mr. I. B. Potter, of New York, on Country Roads; and Mr. Henry Manley, Assistant City Engineer, Boston, on Street Pavements. The lectures of Mr. Blodgett, on Railroad Signals, were attended as usual by the students in the Railroad Option. Excursions have been made to several points of engineering interest, and acknowledgments are again due to President Tuttle, of the Boston and Maine Railroad, and to General Manager W. H. Barnes, of the Boston and Albany Railroad, for courtesies extended to the classes. Notes have been printed during the past year, on Hydraulic Measurements and on Warped Surfaces, both by Professor Porter. A new edition of Professor Allen's notes on Railroad Engineering, for the third year, has also been issued.

Professor Swain adds the following note: "The demand for graduates in Civil and Sanitary Engineering during the past year has been unusually large. It is a fact worthy of remark that in these, the older branches of the engineering profession, — branches that are supposed by many to be overcrowded, — there is a steady and increasing demand for more men than the school can supply. Considering the great development which is taking place, and which must continue, in transportation, in municipal work of all kinds, and in problems involving the public health, such demands for trained men are only natural, and must be subject to much less fluctuation than the ordinary vicissitudes of business. Last June we graduated twenty-eight men in the departments of

Civil and Sanitary Engineering. At last accounts, all of these were employed, while many had had several opportunities which they were obliged to reject; and the professors in the department have had numerous applications for men to which they have been obliged to reply that no men were available. Of the twenty-eight graduates alluded to, at last accounts four were in railroad work, three in bridge and structural work, six in hydraulic work, four in sanitary work, five in general municipal work (one a city engineer), three in highway construction, two in general practice, one an assistant at the Institute, and one temporarily employed. Mr. Lyon, one of our instructors, has had charge, during the summer, of the construction of highways and other works in the town of Hopedale, and many of the students of the third and fourth years have been employed."

Course II. Mechanical Engineering. — The following apparatus has been added to the Steam Laboratory : —

A set of four landings and an iron ladder erected outside the Engineering Building, beside the new iron chimney of the boiler-house, will enable us to make observations of the temperature and composition of the escaping gases, as well as of the draught at different points in the stack, and thus to study experimentally the laws of chimney draught.

A new pair of Crosby steam engine indicators, with their latest improvements.

Apparatus for the measurement of the flow of steam in large pipes.

A large locomotive Hancock inspirator, presented by the Hancock Inspirator Company.

A large locomotive Hogue injector, presented by the Hogue Injector Company.

A pair of exact indicator rigs designed in such a way as to be suitable for use with any locomotive. These rigs were used in a set of locomotive tests for the thesis work of two fourth-year students in Mechanical Engineering.

There has been loaned to the department for the remainder of the school year the Marsh compound pump, with a capacity

of 800 gallons per minute, used for the electric fountain at the recent fair of the Massachusetts Charitable Mechanics' Association.

Three brass water-meters have been loaned to the department by the Metropolitan Company.

A very handsome sectioned model of the Buckeye engine valve-gear has been presented to the department by the Buckeye Engine Company. Besides the above should be mentioned the acquisition, through the kindness of City-Engineer Jackson, Mr. Desmond Fitzgerald, of the Corporation, and Mr. E. D. Leavitt, of a complete set of blue-prints of the detail drawings of the new triple expansion Leavitt engine at the Chestnut Hill pumping-station.

The classes have now increased so much that we are in great need of more large apparatus in the laboratory. It would be very advantageous if we could have, as one such piece of apparatus, a twenty horse-power gas-engine for experimental purposes. During the last school year we were fortunate enough to secure the privilege of having the fourth-year students in Mechanical and Electrical Engineering and Naval Architecture, ninety in all, make, as a portion of their regular laboratory work, a test of the new pumping plant at Chestnut Hill, including the boiler and the triple-expansion engine recently built by Mr. Leavitt to pump water from Chestnut Hill Reservoir to Fisher Hill Reservoir, and thus supply the high service of the city of Boston. The work included tests of the boilers and the engine, and also determinations, by means of weir measurements at Fisher Hill, of the amount of water pumped. It was very carefully conducted under the direction of Prof. E. F. Miller. As a consequence of the skill with which the whole test was executed, we have been offered the use of several pumping plants for a similar purpose.

The following apparatus has been added to the laboratory of Applied Mechanics, viz: —

A small torsion testing-machine, for wires up to one-half inch diameter, enabling us to determine the shearing

modulus of elasticity, and the torsional strength of such wire as is used in the springs of steam-engine indicators, and for other purposes.

A pair of cast-iron skewbacks, weighing about 2,500 pounds each, to be used in testing the strength of brick arches of practical size; and eventually, to form part of a machine, of about 400,000 pounds capacity, for testing arches.

A new and very delicate weighing device has been added to the cement-machine referred to in the last report.

Some additional apparatus has been constructed for measuring stretch on large specimens.

The following series of tests have been or are being carried on by means of the 300,000 pounds Emery machine: —

A series of tests of the strength of spruce columns.

A series of tests to determine the crushing strength, at right angles to the grain, of yellow pine, oak, spruce, maple, and hemlock.

A series of tests of the strength of yellow pine and spruce columns resting against a wooden bolster at one end.

A series of tests on a set of bolted joints in tension, planned, made, and presented by the Boston Bridge Works, to cover a number of practical cases.

A series of tests, now in progress, on sets of bolted joints in steel plate, so planned as to form a part of a systematic investigation of what is the ultimate compressive bearing pressure in a riveted joint. This set is planned by ourselves and is very nicely made and fitted.

Tests were made with the 100,000 pounds transverse machine as follows: —

A series of tests of the strength of timber-headers of a variety of lengths.

Tests of two timber-trusses built of 8-inch by 10-inch timbers.

This last has led to a series of tests, now in progress, on the strength of triangular wooden trusses made of 6-inch by 8-inch timber, with a variety of joints, and with the rafters inclined at a variety of angles.

A revised edition of the Notes on Friction by Professor Lanza was prepared last summer, and has been printed. A description of the new cement machine, including the latest improvement, has been published in the "Bricklayer" by Professor Miller.

An important addition to the publications of the Institute has been undertaken during the year, in presenting, in the Technology Quarterly, the results of tests made in the Engineering Laboratories. This publication was begun largely in consequence of the recommendation made March 14th, 1894, by the visiting committee of the Corporation, under the chairmanship of Mr. Mills, as follows: "Many of the results are capable of being presented to the profession in such a way as to be a great credit to the Institute. It is certainly true of this department, and is probably true of many other departments of the Institute, that a considerable knowledge is attained yearly which the engineering profession is in need of; and it would be valuable to the Institute and to the profession if experimental class work and thesis work were arranged in order to attain such additional knowledge, and provision were made for the prompt publication of such results as are especially valuable as contributions to the knowledge of the profession, by the Massachusetts Institute of Technology." The first instalment appeared in Vol. VII., No. 2, of the Quarterly, covering forty-one closely printed pages. Of these tables, the visiting committee say, in their report of May 24, 1895: "The results given are an addition to professional knowledge on steel, wrought iron and cast iron tension, also tension of iron and copper wire, and a beginning on phosphor bronze and aluminum; also, on compression of cast and wrought iron, and resistance to torsion of wrought iron and steel, and on the strength of manilla and cotton ropes; and a very valuable addition on the strength of large wooden beams." The second part appeared in Vol. VIII., No. 1, covering twenty-eight pages. The third part of these results will appear in Vol. VIII. No. 3; and it is expected that such tables will form a regular feature of the Quarterly, hereafter.

Course III., Mining Engineering and Metallurgy. — As already stated, Mr. Lodge has been promoted to be Assistant Professor of Mining Engineering and Metallurgy, in recognition of his untiring devotion to the advancement of the students, as well as of the assistance he has rendered towards carrying on the mining and metallurgical laboratories with the greatest economy consistent with highest efficiency.

The number of students in the course is about the same this year as last, but the number of candidates for the degree is larger. During the last two years it has been somewhat difficult to place our graduates, on account of the hard times; but now that the tide has turned, there are not enough to meet the calls made upon us. Professor Richards states that he has had eight applications since September in excess of the number of men available.

During the summer Professor Richards made an extended trip, visiting all the principal mining regions in the United States, where concentration works are carried on. The tour was undertaken with the purpose of obtaining the latest data upon American methods of concentration. To secure the best results, Professor Richards was accompanied by a skilled assistant. A large amount of valuable material has been obtained and is now being worked up. In addition to this, several lines of research, to develop experimentally the fundamental principles of ore-dressing, are being carried on in the laboratories. Two assistants have been especially engaged for that purpose. All this work is to be embodied in a book upon American ore-dressing. The present body of students and the laboratories, in their equipment and methods, are deriving much advantage from this direction of Professor Richards' studies and efforts during the past year upon the problems of ore-dressing. Some of the most marked advances which have occurred in recent years have been made under this impulse. The latest inventions for reworking tailings, for the further extraction of the precious metals, have been brought into use; the cupelling and copper-refining furnace is being reconstructed upon better lines than ever before; and

all the new ideas and principles of ore-dressing are being embodied in the course of instruction, as fast as they can be put into shape.

Professor Hofman, besides his regular lecture courses, continues his work upon the subject-catalogue in the library, and upon the fourth year memoirs on professional objects, towards which the former directly contributes. The students of this department enjoy a great advantage from reading professional works in German with Professor Hofman. Under his charge some of the students have been working out methods for determining the fusibility of refractory and non-refractory clays. In the experiments the leading refractory clays of the country and a large number of brick and tile clays have been subjected to fire tests. Professor Hofman read a paper upon the mining and metallurgical laboratories of the Institute before the Society for the Promotion of Engineering Education, at the meeting held last August.

The department library is steadily growing by the purchase of standard books as they appear, and by continuing the files of the current periodicals. A new case is just now being put in to keep up with this growth. The valuable and beautiful Swedish collections, illustrating the processes of manufacturing iron at the four great establishments, Horndal, Österby, Söderfors, and Ankarsrum, are now complete. Mr. Henry M. Howe, of the class of 1871, who delivers each year a course of lectures on the metallurgy of copper, has, during the year, received the medal of the Franklin Institute of Philadelphia, usually given only for mechanical engineering; and the Bessemer gold medal from England, the latter being the highest distinction known to metallurgists. Since I wrote the foregoing, Mr. Howe has received from Germany the gold medal of the *Verein zur Beförderung des Gewerbefleisses*, the chief metallurgical honor of that country. All these tributes have come to Mr. Howe in consequence of his work upon Steel, which is now the standard authority in all lands.

Course IV., Architecture. — The Architectural Department continues its steady gain from year to year. Nothing could

show better that its courses of study are well in accord with the times than the great success last winter of its students in the two competitions inaugurated by the Beaux Arts Society of Architecture in New York, the first of which was mentioned in my last Report. In a fair contest with all the leading schools and draughtsmen's clubs in the country, Institute men bore off both the gold medals, as well as a first or second mention for each other of our entries. The library has been largely increased this past year. We have come into possession of the books of the Rotch bequest; and Mrs. Draper has continued her donations, now embracing several hundred volumes, many of them rare and costly. We have also to thank Professor van Daell for his gift of "Antiquités de la France," and Messrs. Bates and Guild and Mr. Ross Turner for various photographs.

At the present time, so great has been the growth of the department, we are handicapped for space, both in the library and in the fourth-year drawing-room. It is of the utmost importance that this want be met before another year. The graduating class in the study of their theses need twice the space for drawing-boards, reference-books, etc., allotted to the other classes. The next year's class will be still larger. Added to this, we have to care for the graduate students, with their still more important theses, requiring every facility of working space, and the readiest access to the library. The library has been growing much faster than seemed possible when the present room was first devoted to it. It has been so liberally aided by donations that now it stands unsurpassed as a working library in all except space for the best use of the books. The fourth-year class, with the graduate students and the library, should each have an entire floor; at present they have a floor together. If the needed space cannot be found elsewhere, I see no other way, within our present walls, than to sacrifice the museum and exhibition-room in the basement, and make of it the recitation-room for that department. But this would be a step so much to be regretted that we may well look around in every direction before considering the details of this scheme.

Courses V. and X., Chemistry and Chemical Engineering. — The number of students in the analytical laboratory this year is 112, distributed among the courses as follows: Fourth year, Mining Engineering, 10; Chemistry, 2; third year, Mining Engineering, 9; Chemistry, 30; Biology, 4; Physics, 1; Sanitary Engineering, 3; second year, Civil Engineering, 1; Mechanical Engineering, 1; Chemistry, 33; Biology, 6; Physics, 4; Chemical Engineering, 8.

One corner of the analytical laboratory has been partitioned off to serve as an office and private laboratory for Professor Talbot. This has been done with a sacrifice of but three working places for students, and makes possible a closer contact of instructor and students, which has long been desired. The room formerly occupied by Professor Talbot as a private laboratory is now needed for the instructors' use.

With the apparently increasing number of students electing the Course in Chemistry, the accommodations in the analytical laboratory must soon prove to be very inadequate. After the students have chosen their courses in January, the number of required places will be known. It is a requisite to proper chemical manipulation that each student shall have a reasonable desk space, and sufficient closet-room for the suitable storage of his apparatus. This it will be impossible to give, if the desks, originally designed for a single student, have to be divided and assigned to two students. This it has been already found necessary to do in some instances; but it has so far been possible to assign to each student of Course V. an entire desk for his own use. Room 39 is now utilized for the laboratory course of molecular weight determinations, formerly crowded into the small laboratory, Room 46 A. The course is in charge of Dr. Fay; and the larger space, which can be utilized for apparatus, contributes materially to the efficiency of the instruction. The smaller room, 39 A, formerly Dr. Drown's office, is now used as a much needed recitation-room for small classes, though without fittings for this purpose. Under the direction of Mr. Rolfe, a laboratory has been fitted up in a portion of Room 32, for the optical and

chemical analysis of sugars, starches, etc. Mr. Rolfe's training and practical experience on sugar plantations at Solidad and Parque Alto in Cuba, and with the Charles Pope Glucose Company, has fitted him to conduct this course with unusual breadth of view, emphasizing both the theoretical and practical sides in such a way as to make it of peculiar value to our students. The course should compare very favorably with similar courses given in any other institution. One of our graduate students is at present conducting thesis work under Mr. Rolfe's direction. The equipment of the Kidder Lecture Hall with electric lights has added much to its usefulness, both for evening lectures and when the lectures are illustrated with the lantern.

The work in Sanitary Chemistry, which was at first a special branch of analytical chemistry, has expanded during the last few years in a remarkable degree, and now brings into its scope some of the latest methods of biological science, while it is intimately associated with engineering. In connection with the analyses of potable waters for the State Board of Health, the students of the Courses in Chemistry, Biology, and Sanitary Engineering, have an opportunity to become familiar with this new branch of inquiry in its practical operation on a very large scale. Notes on this subject, with directions for the proper interpretation of results, were printed last winter, and notes on kindred topics are now in type. This subject gives an unusually interesting example of the value, for educational purposes, of a completely developed technical method of investigation. The interest in this course is shown by ever-increasing demands for increased time in the curriculum, and for enlarged space in the laboratories. The latter demand can scarcely be met with our present accommodation. Of special importance, moreover, to the value of this study is the testimony of students who desire to take research-work in it, and of graduate students from this and from other institutions who come to our laboratories to make investigations. Several papers on sanitary work have been published, or are in preparation. One investigation of importance upon

the theory of the nutrition of the ground (soil fitted for vegetation) was begun by the first class in Sanitary Engineering in 1890, and was completed last summer by Mr. Rolfe. Investigations of this class can be carried on by the small or great contributions of a number of workers under proper direction; and the course has prospered under the indefatigable supervision of Mrs. Richards. One of the assistants, Mr. Meserve, a graduate of last year, divides his time between sanitary chemistry and gas analysis and oil testing.

The policy of the Institute, in view of its function as a technical school, has been to give training of a higher character than mere routine practice of technical analysis affords; and whenever a subject is capable of a complete theoretical and practical treatment, it has been put in charge of an assistant professor, or an instructor, who has usually qualified himself for this branch of teaching by special studies in the laboratories of Europe. Dr. Gill has successfully directed the study of Gas Analysis (five lectures and fifteen hours laboratory work) given to the chemists and chemical engineers. This course treats of the analysis of chimney gases. The lectures consider also the question of fuels, and the means for the prevention of smoke, as stokers, smokeless furnaces, and gas-firing. The department has been the recipient, during the past year, of a valuable set of high-temperature thermometers, for determining the temperature of flue-gases and feed-water, from the Hohmann and Maurer Company of Brooklyn, N. Y. During the past year Dr. Gill has also offered a course in the Analysis and Testing of Oils, given in the fourth year to the chemists and chemical engineers. It embraces twenty-five hours' work in the laboratory, and a series of five lectures, and includes the determination of specific gravity, viscosity, and friction; also of flashing and firing points, and the liability to spontaneous combustion. Thus attention is paid to the examination of oils, both from the point of view of the engineer and from that of the insurance inspector. Methods for the complete analysis of oils are also given. Another branch of analytical

chemistry has been essentially modified since the appointment of Mr. Rolfe. The instruction in sugar analysis, given by Mr. Rolfe, comprises four lectures and laboratory exercises. The student is made familiar with the use of different kinds of polariscopes, and their construction; and is taught how to standardize sugar scales in rotary degrees, by the use of quartz plates. Determinations are made of sugars and syrups according to the best methods in use commercially, and the general problem of determining the specific rotary power of any substance is taken up. A class of ten students takes this course.

In the sugar laboratory radical changes have been made. Instead of converting the whole place into a dark-room, the object has been obtained by enclosing each instrument in a wooden-hood. This arrangement is conformable to the usual practice, and gives obvious advantages as to cleanliness, convenience of working, and inspection of work. Facilities for lighting scales of instruments have been arranged which obviate the dirt and danger of constantly lighting matches. Advantage has also been taken of the alterations made in the analytical laboratory to have an old laboratory bench transferred and set up in the sugar laboratory; this has proved a great convenience. The expenditure of a small amount in the repair of old instruments, and the purchase of other instruments, has resulted in fairly equipping the laboratory for work. It is now possible for three students at a time to work comfortably and rapidly.

In Textile Coloring, Mr. J. W. Smith has given the usual course of fifteen lectures and seventy-five hours' laboratory work to fourteen students taking this fourth-year option. This system of instruction illustrates all the chemical principles involved in dyeing, and their practical application under the direction of Mr. Smith has given this branch of industrial chemistry a high reputation. Forty students have taken the third-year option of laboratory instruction in industrial chemistry. The work is carried on, as in the metallurgical department, on a sufficiently large scale to give a fair idea of

factory work. The object of the instruction in this laboratory is to train the pupils in methods of carrying out technical processes where the results must be obtained at the least expense. The economy must be not only one of materials, but should also include saving in labor, time, fuel, and plant or apparatus necessary. To attain this result the student is required to examine his materials, testing all acids, etc., calculate the amount of each ingredient required, the best quantity of water for solution, and the size of apparatus best suited for the work. The quantity of material handled in each experiment may vary from one to fifty pounds. Students taking this option also make a few experiments on dyeing cotton, wool, and silk, and bleaching cotton. Mr. Smith remarks that at some future time the addition of a filter-press, built on the model of large filter-presses in use, will be of great service.

ORGANIC CHEMISTRY. — The importance of the training to be derived from the study of this most rapidly progressing branch of chemistry has become more fully recognized. The chief work of the chemical students in the fourth year is now in the organic laboratory; and some problem in this field usually forms the subject of the students' theses. Every effort has been made to find such topics as may fit the skill of the individual students, and encourage their efforts by the production of positive results worthy of a place among the records of science. The task is by no means easy, by reason of the short time allotted to research in the crowded curriculum of the school. Original investigations can be taken up with greater hope of success by graduate students, who, following the usual custom of European laboratories, give their whole time to a single subject. Dr. Noyes has this year been ably seconded in the direction of the laboratories by Dr. Norris and Dr. Mulliken. Dr. Noyes adds the following remarks: —

"The course of organic laboratory instruction has, it is believed, been materially improved during the past year by the introduction of a new special course of experiment on the detection and separation of the various classes of organic

substances. Cyclostyled notes — to be printed during the present year — have been prepared to accompany the course. In general a distinct gradual improvement, in both the quality and the quantity of work accomplished, is noticeable from year to year, as the courses of instruction become more systematized. The results of thesis work were also rather more satisfactory during the past year. During the second term sixteen students made investigations in the organic laboratory, and presented theses, of which number, thirteen were accepted by the Faculty as satisfactory. Abstracts of five of these theses have been already published, as well as of two investigations in theoretical chemistry made by graduate students. It seems imperative to call attention to the fact that the limit of accommodation as to the number of students has been reached in the organic laboratory. The laboratory has places for twenty students, and of these at this time nineteen are occupied. The present third-year class of the Course in Chemistry, however, consists of thirty-one students ; and it is to be expected that about that number will apply for admission to the organic laboratory at the beginning of next year, for the accessions from other institutions have usually fully compensated the few withdrawals during the third year. Moreover, the present second-year class consists of thirty-three members; so it is not merely a question of provision for one year."

The usual number of additions have been made to the Chemical Library during the past year. The efficiency of this valuable adjunct has been materially increased by the appointment of an assistant librarian who is constantly in attendance. This was rendered necessary partly by the rapid growth of the library, and partly by the withdrawal of Mr. Andrews, who, in addition to his work in the general library of the Institute, had for many years continued his special supervision of the chemical library, which dated back to the period before he became Institute Librarian. It did not seem desirable to ask Dr. Bigelow, who has succeeded Mr. Andrews in the librarianship, to assume any special relation to the chemical

library, which, in his case, would have lacked the traditional character which belonged to Mr. Andrews' connection with that library, and which, in the rapidly extending work of the Librarian's office, it would be increasingly difficult to maintain. Among the gifts to the chemical library the past year, the most notable is that already mentioned in speaking of Mr. Gaffield's gifts to the Institute.

INDUSTRIAL CHEMISTRY. — In Industrial Chemistry, the usual course of lectures has been given by Dr. Thorp to fifty-six students, the largest class for some years. As heretofore, certain subjects have been presented by chemists outside of the Institute, each speaking of his special work with the minute acquaintance given by industrial experience. The following is the list of special lecturers in this department: Mr. Frank G. Stantial, on Sulphuric Acid; Mr. Charles D. Jenkins, on Illuminating Gas, and on Pottery and Tiles; Mr. Louis J. Schiller, on Sugar and Sugar Refining; Mr. Arthur D. Little, on Paper; Mr. Webster Norris, on Rubber. It is also intended to arrange for the customary visits of the class to chemical works and manufacturing establishments. The collection of samples, illustrating the subjects treated in this course, has been enriched by Mr. Gaffield's gift of specimens of glass, glass-workers' tools, and models of glass-furnaces, already spoken of. A suitable room, with cases for the proper display of our large collection of samples, would add much to the efficiency of the work.

No changes worthy of special note have occurred in the Course in Chemical Engineering during the past year. The loss of Professor Drown is felt with especial severity here, as he had taken a particular interest in the development of this branch of instruction, so far as the chemical side was concerned. The work on the engineering side is undergoing gradual progressive development.

In the "Technology Quarterly" for April, 1895, the following announcement was made, under the title, "Review of American Chemical Research," by Professor Noyes, as editor:

"The purpose of this publication, which is hereafter to

appear serially in this journal, is to present in a concise form a review as complete as possible of all original work having a chemical bearing published in the United States after the beginning of the year 1895. It is believed that such a compilation will prove of more than usual value in the case of the research work of this country by reason of the fact that so large a proportion of it is published in other than chemical journals, and thus fails to become incorporated with the rest of the science, and also because the abstracts of American chemical literature published in foreign journals are very incomplete.

"The execution of the plan has been made possible by the cordial co-operation of members of the instructing staff of the Institute of Technology. The following is a list of the present abstracters: C. W. Andrews, Chemistry of Sugar; W. O. Crosby, Geological and Mineralogical Chemistry; A. H. Gill, Gas Analysis, Fuels, Oils, and Apparatus; H. M. Goodwin, Physical Chemistry; H. O. Hofman, Metallurgical Chemistry and Assaying; A. A. Noyes, General and Organic Chemistry; E. H. Richards, Sanitary and Agricultural Chemistry; J. W. Smith, Dyeing and Bleaching; H. P. Talbot, Inorganic and Analytical Chemistry; F. H. Thorp, Technical Chemistry."

The work here outlined has been successfully conducted since that time, during three issues of the Quarterly, and is expected to prove of much interest and value.

The following list includes the principal publications by members of the Chemical Department during the past year:

Theoretical Chemistry.

A. A. Noyes and C. G. Abbot: Prüfung der Prinzipe der Löslichkeitsbeeinflussung.

A. A. Noyes and W. T. Hall: Die Geschwindigkeit der Hydrolyse des Salicins durch Säuren.

A. A. Noyes: Geschwindigkeit der Reaktion zwischen Zinnchlorür und Eisenchlorid. Eine Reaktion dritter Ordnung.

A. A. Noyes and W. R. Whitney: Kryoscopische Untersuchungen mit Aluminaten und Boraten von Alkalimetallen.

A. A. Noyes and W. O. Scott: Beitrag zur Kenntniss der Geschwindigkeit von polymolekularen Reaktionen.

Organic Chemistry.

George Defren: Ueber die Darstellung des p-Aethyltoluols.

A. A. Noyes and R. M. Ellis: Synthesis of Diphenylbiphenyl and its Identification as Benzerythrene.

A. A. Noyes and J. T. Dorrance: The Electrolytic Reduction of Para Nitro Compounds in Sulphuric Acid Solution.

A. A. Noyes and W. H. Watkins: Occurrence of Trimethylene Glycol as a By-Product in the Glycerine Manufacture.

Sanitary Chemistry.

T. M. Drown: The Mineral Contents of Deep Wells in the Vicinity of Boston. Report to the State Board of Health as Chemist.

Ellen H. Richards: Notes upon Water Analysis, prepared for the students of the M. I. T. Notes upon Sanitary Chemistry, prepared for the students of M. I. T.

Ellen H. Richards and J. W. Ellms: The Coloring Matter of Natural Waters.

A. H. Gill: A Modification of Hinman's Gas Explosion Pipette; Notes upon the Determination of Nitrites in Potable Water; A Short Handbook of Oil Analysis, prepared for students of the M. I. T. An Improved Pipette for the Absorption of Illuminants from Gaseous Mixtures.

A. H. Gill and S. P. Hunt: The Determination of Methane and Hydrogen by Explosion.

George W. Rolfe: Report of Chemical Work on Waring's Process of Purifying Sewage.

Courses VI. and VIII., Electrical Engineering and Physics. — The work in Physics and Electrical Engineering has been performed during the past year under difficulties arising from various causes beyond the control of any one. The necessity for the exercise of unusual economy, an instructing force

inadequate for the largely increased number of students, and rooms not altogether suitable for the work laid out, — these necessarily prevented any striking development of the department. But though at the time there was much that seemed discouraging, and though, measured by our ideals, we did less than we could wish, yet, on looking back over the year, it is evident that solid progress has been made, in spite of all drawbacks and deficiencies. One new laboratory has been opened, the Physico-Chemical Laboratory, an account of which was given in the President's Report for 1894. The instruction given therein has been very successful; and during the coming term this laboratory will be opened to students in the Course in Chemistry, as well as to those in Physics. The courses already established have been improved; and several new short special courses have been added. Through the liberal appropriation for apparatus and supplies which was provided to the department by the Executive Committee, we were able to make very material improvement in the apparatus of the laboratories of general physics, electrical measurements, and electrical engineering, so that we begin the present year with much better facilities than ever before.

The increased requirements in mathematics for admission to the Institute, as was intended, have affected, not only the more advanced mathematical work, but likewise all professional work depending upon mathematics. This allows us to begin the instruction in theoretical electricity a term earlier than heretofore, a change which in its turn has involved certain corresponding changes in the lectures in physics given to all students in the second year. The lectures on electricity in that course have to come much earlier than formerly, so that the lectures on optics come later, the order of the two subjects being reversed. Professor Cross felt some doubt as to the success of this plan; but in practice he finds that it has worked satisfactorily. The additional mathematical knowledge possessed by the class at the beginning of the second year also allows a distinct advance to be made in the

grade of the course in second-year physics, a matter of some importance on account of the fundamental position of these lectures in our scheme of instruction.

Several changes have been made among the "lecturers for the current year." As in previous years, the Course on Railway Signalling was given by Mr. George W. Blodgett, '73, Electrician of the Boston and Albany Railroad., and that on Telephone Engineering by Mr. H. V. Hayes, '85, Electrical Engineer of the American Bell Telephone Company. But, on account of removal from the city, Mr. J. P. B. Fiske, '89, was unable to continue to deliver the course on Electromotors, and Mr. W. C. Fish, '87, Superintendent of the General Electric Company's works at Lynn, assumed that duty. The lectures on the Design of Dynamo-Electric Machinery were given by Mr. H. M. Hobart, '89, of the General Electric Company, Mr. Parshall, who was to have taken charge of them, being abroad on business. As this is likely to be the case during the present year, Mr. Hobart will continue to deliver these lectures. Three new courses, by gentlemen actively engaged in professional life, have been added, — one, by Mr. Hollis French, '89, upon Electrical Engineering Practice and Specifications, which is intended to teach the student the proper manner of dealing with the practical problems that arise in laying out and completing large work in electrical engineering; a second, by Mr. Howard C. Forbes, '91, upon Commercial Electrical Testing, designed to teach the manner of conducting such work economically and accurately; and a third, by Mr. Odin B. Roberts, '88, on the Nature and Function of Patents for Inventions, designed to teach those fundamental principles of patent law and practice which should be understood by any one having to deal with the study of novel inventions and their applications. Besides these longer courses, one or more lectures were delivered by each of the following gentlemen: Mr. C. A. George, of the Boston Municipal Fire Alarm Telegraph Service, on Municipal Fire Alarm Systems; Mr. C. J. H. Woodbury, of the American Bell Telephone Company, on Electricity.

in its Relation to Fire Risks; Mr. W. S. Moody, of the General Electric Company, on Alternating Current Apparatus; Mr. E. E. Cary, of the Beacon Incandescent Lamp Company, on the Manufacture of Incandescent Lamps; and Professor Elihu Thomson, on Recent Developments in Applied Electricity.

I must again allude to the lack of room, a matter to which attention was called in the President's Report for 1894. The difficulty was serious last year, with forty students in the fourth-year class. During the present year, with over sixty such students, it is much more difficult to carry on the thesis work, and keep the instruction on the existing scale, and up to the present standard. Nor is this difficulty confined to the laboratories. There is at times an extreme pressure upon the lecture and recitation rooms.

Reference was made in the last President's Report to the need of an additional plant of dynamo-machinery in the laboratory. That need still exists, and is greater than ever. From its current appropriation for apparatus the department has been able to add considerably to its facilities in this direction; but the desirability of larger and more extensive apparatus than has thus been supplied cannot be overstated. This Institute was the pioneer in this branch of engineering education, as in so many others; but if it is to maintain its present place, it is imperative that some further facilities in this direction shall be placed at our disposal.

Course VII. Biology. — There remains but one drawback to the steadily-increasing usefulness of this department, and that is a painful lack of room. One hundred and three regular or special students of the Institute, besides thirty-four senior students of the Boston Normal Schools of Gymnastics and Cookery, making a total of one hundred and thirty-seven, are under instruction in the single room to which the work of the department is restricted. Of these the number doing laboratory work is one hundred and twenty-five. The several classes of the present term are attended as follows: General Biology, 38 students; Comparative Anatomy, 10; Anthropology, 16; Physiology and Hygiene, 19; History of the

Inductive Sciences, 12; Physiology of the Senses, 3; Microscopic Anatomy, 6; Physiological Laboratory, 8; Comparative Physiology, 8; Theoretical Biology, 13; Bacteriology and Micro-organisms of Fermentations, 28. The growth of interest in the last-mentioned subject, and its practical importance, have made necessary large additions to equipment and stock, and the same thing is true all along the line. Within the last three years the change in this direction has been very great, so that if to-day an adequate building were available for the uses of this department, it could almost immediately be furnished with a good working equipment at small additional cost.

The class in bacteriology and the micro-organisms of fermentations includes this year eight senior chemists and four seniors in Sanitary Engineering. The increasing practical importance of a familiarity with these subjects to both professions is likely to make this class still larger in the near future. Nowhere, perhaps, is the need of proper laboratory accommodations more keenly felt than in these subjects, which, for securing the best results, ought to have quiet, dust-free rooms, but must now be pursued in the same room which is used, at other hours, for classes in physiology, general biology, zoölogy, and botany.

The course in anthropology has long formed a stepping-stone, for students in the Courses in Biology and in General Studies, from zoölogy to sociology and political economy. It is now given jointly by Professor Sedgwick, of the Department of Biology, and Assistant Professor Ripley, of the Department of General Studies, most of the burden of instruction falling upon the latter.

The course in general biology, required of all beginners as well as of those who intend to go far in the subject, and attended by numerous teachers, is given, as heretofore, by Professor Sedgwick. The courses in physiology for senior students are in charge of Assistant Professor Hough; and have become so valuable that many professional teachers, as well as the regular students of Course VII., have sought admission

to the classes. For example, the briefer course in physiology and hygiene, originally intended for the senior students of the General Course, is attended this year by ten teachers in active service in the public schools of Boston and vicinity. Dr. Bigelow's place on the instructing staff of this department has been taken by Mr. Henry E. Crampton, Jr., of Columbia College.

A prominent feature of this department has become its contribution to the educational forces of the State in the training of teachers. Not only have many of the regular or special students of the department adopted teaching as a profession, but within the last three years a large number of teachers actually engaged in their profession have embraced the opportunities offered by the Institute. The number of professional teachers in attendance last year, in this department alone, was twenty-five, and already in the first half of the present year it has risen to thirty-three.

During the year Professor Sedgwick has published an enlarged and revised edition of his text-book on "General Biology" (with Prof. E. B. Wilson of Columbia College); a paper "On the Bacterial Contents of Certain Ground Waters, especially Deep Wells" (with S. C. Prescott, S. B.); a paper "On the Influence of Variations in the Composition of Culture Media upon the Development of Water Bacteria" (with S. C. Prescott, S. B.); a paper "On the Epidemic of Typhoid Fever in Marlborough, Mass., apparently Due to Infected Skimmed-Milk," — so far as is known the first case of the kind reported in America; and an address upon "The American College as a Moral Force," delivered before the American Institute of Instruction in 1894. Assistant Professor Hough has also published an important physiological paper upon "The Escape of the Heart from Vagus Inhibition." Professor Sedgwick continues to act as Biologist to the State Board of Health, and has lately served as a member of the Jury of Awards at the Atlanta Exposition, having been assigned to the Committee on "Liberal Arts," and the sub-committees on 'Hygiene and Sanitation" and "Technical Education."

For several years the Institute has enjoyed the use of an investigator's private laboratory in the Marine Biological Laboratory at Wood's Holl, the gift of Mrs. William B. Rogers. During the season of 1895 this table was occupied, with great advantage, by Dr. Bigelow, Instructor in Biology, and Mr. Clarence W. Perley, a fourth-year student.

Course IX., General Studies. — The work of the General Course has been carried on the past year with unabated interest on the part of both teachers and scholars. The new course in anthropology already mentioned has developed to a degree which makes it one of the most satisfactory of all the studies in this department. Professor Ripley is showing high quality in his work, both as an investigator and as a teacher.

Mr. George A. Gardner, of the Corporation, has made two valuable gifts to this department during the year, which largely increase its collection of anthropological material. The first of these comprise thirty racial masks, made and colored from life by Dr. Finsch, of Bremen, during voyages in the Pacific and in Asia. The second gift, which has not yet arrived from France, consists of a series of reproductions from the famous collection of busts of primitive races now in the Museum of Natural History at Paris. This latter collection is composed of representatives of the several African races, thus supplementing the Finsch masks, which are taken from the Asiatic and Polynesian types almost exclusively. These busts were all made from life by experts during the explorations on the "Astrolabe," "Zelée," and "Favorite." They are especially valuable as they show the head form, while the Finsch masks only indicate the features and the color of the skin. It is the intention of the department to establish a small anthropological laboratory for the prosecution of studies especially directed upon the elucidation of sociological problems. Two students will make their graduation theses this year in researches upon the students at the Institute. The work will be carried on by the co-operation of the Departments of Biology and of General Studies.

The English department recognizes the fact that its first

practical duty is to train the student to write sound and effective English, so that composition may become one of the useful instruments in his technical life. The work of some of the students in technical memoirs prepared in other departments has for several years been corrected by the teachers of English. The success of this has been so marked that it is earnestly desired to extend the plan. A beginning of work in another direction has been made by combining with the composition drill of first-year students, the criticism and correction of translations which the department of Modern Languages caused to be made for that purpose. It is strongly felt by the department, however, that of equal importance with this direct practical training in composition is the awakening of the minds of the students to the value and the meaning of literature. The interest which has been shown by the second-year students in the course in English literature, which is required of the whole class, has been particularly gratifying. The time allotted to this is insufficient, especially in the first term; and less can be done than should be done. In general, the attitude of the students toward broadening and liberalizing branches seems to be gratifyingly intelligent and cordial, — a fact which is of especial importance under circumstances so inevitably tending to concentrate attention upon purely technical subjects.

In History, Professor Currier shows an increasing strength in dealing with the weighty burden which Professor Levermore's resignation threw upon him.

The appointment of an additional instructor has enabled the department of Modern Languages to divide the classes in French and German into smaller sections, to the very great advantage of the students. It is much to be desired that further progress should be made in the same direction, when the means of the Institute will permit.

The lectures on Business Law, given by Louis D. Brandeis, Esq., of the Suffolk Bar, have proved a notable and most useful feature in our course of instruction. For Mr. Brandeis's convenience, it has been arranged to give this course

in alternate years, to students of the third and fourth year classes. The lectures have been attended by large numbers of students beside those on whom the course was obligatory, and the greatest interest has been manifested by all in the instruction given. Mr. Brandeis has, it seems to me, to a remarkable extent overcome the difficulties attending a course in such a subject given in a scientific school, where the time at command is closely limited. He has made use to the utmost of the special aptitude which students of technology and science possess for dealing with concrete cases, and has built up a course of instruction which is unique.

Course XII., Geology. — During the year 1894–1895, the aggregate number of names upon the lists of the classes taught in the Department of Geology was three hundred and ninety-nine. All of the specialized and advanced courses enumerated in the Catalogue have been given.

The amount of work being performed in the geological laboratory at the present time is much greater than it has ever been before. There are at the present time four students in the fourth year of the Course in Geology taking advanced work. The mild and favorable weather of the autumn has enabled the instructors to carry on the work in the field to a more satisfactory extent than it has been done in some other years. Professor Crosby conducted a party of twelve students through the noted mineral localities of northern New York and Canada, during three weeks of last summer. Besides valuable additions to the mineral collections of the Institute, and the practical experience of the students, many interesting geological studies were made of localities which afforded excellent opportunities. Mr. A. W. Grabau, of the fourth year in the Department of Geology, spent eight weeks last summer in a careful and detailed study of one of the most interesting fossiliferous regions in the State of New York, viz., Eighteen Mile Creek; and he has brought to the Institute important additions to its collections. During the year a number of donations of specimens have been received, the most important being the one by Mr. Thomas Gaffield,

of exceedingly choice and rare minerals and crystals as already mentioned. The work of so arranging the collection for instruction in palæontology that each student in the class may be supplied with a tray of representative specimens giving an epitome of the structure and classification, has been carried on successfully. At the present time there are ninety-eight trays which have been in part prepared for this work; but there are still vacancies to be filled as opportunity is presented for obtaining suitable specimens. The usefulness of the distinctly geological work of the department is limited by the cramped condition in which the collections and library are at the present time. The room in which the instruction in blowpipe analysis is given is far from satisfactory, being too small for the classes, and not easily ventilated.

Course XIII., Naval Architecture. — The first class, numbering five, was graduated from this department last June. It may be interesting to give the titles of the theses presented for graduation. They were:—

The Stability of the Oil-steamship "Maverick;" involving an inclining experiment to determine the location of the centre of gravity, and calculation of stability during the process of loading or unloading.

The Design of an Ocean Tow-boat; consisting of the collection, arrangement, and use in design of information concerning the use and construction of tow-boats.

Tests on the Steamship "Brookline;" a trip to Jamaica and return, during which a continuous three days' test was made at sea on the engine and boilers of the steamship, with determinations of steam and coal consumption.

The development of the course during the past year has been mainly internal, extending and improving the material and methods of teaching. Systematic instruction will be given this year on ventilation of ships and adjustment of compasses. The need of additional space is more keenly felt as the number of students in the department increases, and as material accumulates. Material improvement in kind and amount of work may be expected when adequate space is

available. A model of the steamship "Gloucester," of which the department has a complete set of drawings, has been made with a view to giving students practice in laying out plating.

Professor Peabody, the head of the department, during the summer vacation made an extensive tour of shipyards and engine works, both governmental and private, in England and France, and inspected many of the latest and best examples of naval architecture, in process of construction and in commission. A large number of photographs of all types of naval vessels, old and new, were obtained, to be used as illustrations. In view of the fact that our students have, during the last five years, been engaged in calculating the stresses produced in the frame of the engine and in the hull of the ship by the action of the reciprocating parts of the engine, it is of interest to observe that, when visiting an important shipbuilding and engineering company on the Clyde last summer, Professor Peabody found that, in designing the engines for a large "torpedo destroyer," the officers of the company had reached the conclusion that it was highly important, and even necessary, to bring this element into their calculations. In speaking of our course in Naval Architecture, it may not be inappropriate to refer to the great triumph in yacht building achieved during the past year by Mr. Nathaniel G. Herreshoff, of the Institute class of 1870, in the design and construction of the "Defender."

Two of our number have died during the year. Hon. Alexander H. Rice joined the Corporation in 1863, and from that time onwards was an interested and active member. He served on various committees, and gave freely of his time and strength to the welfare of the school, whose objects he heartily appreciated and whose success he labored to promote. Mr. Cheney joined the Corporation in 1882. Although his extensive financial relations prevented his giving any considerable attention to the business of the Institute, he showed his sincere interest in its welfare by a generous bequest in his will. The lapse of time has not diminished, but has, the rather, increased our sense of the loss sustained in the death

of our colleague, Mr. Henry Saltonstall, of which I spoke to the Corporation a year ago. The longer we go without his cheering presence, his splendid enthusiasm, his high moral courage, and his masterly grasp of business, the more painfully we feel the want of them. Surely no school ever had a wiser, braver, stronger friend and counselor!

Commonwealth of Massachusetts.

IN THE YEAR ONE THOUSAND EIGHT HUNDRED AND NINETY-FIVE.

Resolve in favor of the Massachusetts Institute of Technology.

Resolved, That there shall be paid annually, for the term of six years, from the treasury of the Commonwealth to the treasurer of the Massachusetts Institute of Technology, the sum of twenty-five thousand dollars, to be so paid and allowed from the first day of January in the year eighteen hundred and ninety-six, to be expended under the direction of said corporation for the general purposes of said Institute.

Resolved, That in addition to the amount provided for above, there shall be paid annually, for the term of six years, from the treasury of the Commonwealth to the treasurer of the Massachusetts Institute of Technology, the sum of two thousand dollars, to be so paid and allowed from the first day of January in the year eighteen hundred and ninety-six, to be expended for ten free scholarships, under the direction of the State Board of Education; said scholarships to be awarded only to graduates of the Massachusetts public schools.

HOUSE OF REPRESENTATIVES, *April* 12, 1895.

Passed G. VON L. MEYER, *Speaker.*

IN SENATE, *April* 16, 1895.

Passed WILLIAM M. BUTLER, *President,*

APRIL 17, 1895.

Approved, F. T. GREENHALGE.

TREASURER'S REPORT.

STATEMENT OF THE TREASURER.

THE treasurer submits the annual statement of the financial affairs of the Institute for the year ending September 30th, 1895.

The year closes with an excess of expenditure over current income of nearly $16,000. The receipts from students' fees have increased about $5,700, but this is for the most part offset by the increased expenditure made necessary by the larger number of students.

The percentage of return upon investments has fallen from five per centum last year to four and three-quarters per centum this year. This is unavoidable, since the return on all thoroughly good securities is now less than it was on investments made at an earlier time.

The value at which the buildings have stood on the books has long been known to be above their real worth, and this year, in view of the greatly reduced valuation made by the Board of Underwriters, it has seemed best to make a corresponding reduction in the valuation in our books. Accordingly, a reduction of over $195,000 has been so made. This, of course, has no effect on the real value of the property, but it makes the figures correspond much more closely with the actual facts.

The Institute has during the year received a number of liberal bequests and gifts.

Under the will of Mr. Arthur Rotch $40,000 were received for the architectural department. Of this sum $25,000 are given for the general purposes of the department, and the remainder for special objects.

From the estate of Mrs. Augustus Lowell $5,000 were received, which by the vote of the executive committee, have been invested and constitute the "Katharine B. Lowell Fund."

Five thousand dollars were given by Mrs. Mary E. Atkins to found the "Elisha Atkins Scholarship."

Under the will of Mrs. Betsey F. M. Nichols the Institute received $5,000 to establish the "Nichols Scholarship" in memory of the late Professor Nichols, to whose ability and devotion the Institute owes so much. Another bequest was that of forty shares of The Molsons Bank, Montreal, valued at $3,000, from the late T. Sterry Hunt.

The executors of the will of Mrs. Catherine P. Perkins have paid $7,500 in addition to the large sums previously received, and similarly a further payment of $10,598.73 has been made under the will of William J. Walker. Five hundred dollars more have been received from the William Perry estate.

In addition to the above bequests, final payments under the subscription of 1892 were made, amounting together to $7,500. Mrs. William B. Rogers gave $200 for the purchase of periodicals; and other gifts, amounting in the aggregate to $925, were received.

Another satisfactory matter is the saving in coal which has been made this year. This amounts to about $1,500, and can be mainly traced to the improvements made in the new boiler house. This saving was predicted, and it is satisfactory to find the prediction verified.

Owing to the bequests and gifts above mentioned, the property of the Institute has increased during the past year in spite of the excess of expenditure over current income, and it has therefore been possible to pay off $70,000 of the debt, which has thus been reduced from $220,000 to $150,000.

SECURITIES SOLD OR PAID. GENERAL FUND.		
2,000 Bur. & Mo. River R. R. 6s. non-exempt	2,000.00	
27 Shares Brookline Gas Co.	2,430.00	
		4,430.00
RECEIVED SECURITIES. GENERAL FUND.		
40 Shares The Molsons Bank, Montreal, par 50	3,000.00	
PURCHASE OF SECURITIES. GENERAL FUND.		
2,000 Bur. & Mo. River R. R. 6s. exempt .	2,310.00	
3,000 Illinois Central R. R. 4s.	3,053.58	
PURCHASE OF SECURITIES, WM. B. ROGERS MEMORIAL FUND.		
Scrip. K. C. Memphis & Birmingham R. R.		
$80 General mortgage 4s. . . . . }		
160 Income 5s. . . . . }	66.40	

GEORGE WIGGLESWORTH, TREASURER, *in account with*
GENERAL STATEMENT OF RECEIPTS AND DISBURSEMENTS
Dr.

Cash balance Sept. 29, 1894		24,725.56
From Augustus Lowell for Lowell Courses	6,000.00	
" " " " C. Kastner's salary	2,500.00	
" " " " School of Design	500.00	
		9,000.00
RECEIPTS FOR CURRENT EXPENSES.		
Income of funds for salaries	4,161.00	
" " " " scholarships (students' fees)	4,050.00	
" " " " " " " 1894	450.00	
" " " " Joy "	200.00	
" " " " Swett "	400.00	
" " " " Savage " $592.83; 1894, $207.17	800.00	
" " " " Library	237.50	
" " " " general purposes	9,853.82	
" " Rogers Memorial Fund	9,688.25	
Students' fees	217,813.00	
State Agricultural Fund	5,541.08	
State Endowment Fund	7,000.00	
Laboratory supplies and breakages	8,255.78	
Rents, per Table (page 86)	11,632.31	
Gifts	1,125.00	
Interest	3,262.30	
Pope Fund for Highway Engineering	1,200.00	
" " " " used 1894	1,162.07	
Letter-Box Fund, $61.75, used of 1894, $63.25	125.00	
Boston University	1,150.00	
Sale printed Lecture Notes	3,204.70	
Profit and Loss, expenses more than income	15,935.29	
		307,247.10
BEQUESTS FOR SPECIAL PURPOSES, ETC.		
Increase James H. Mirrlees Fund,	2.10	
" Elisha Thacher Loring Fund,	28.15	
" Richard Perkins Fund,	153.45	
" Charlotte B. Richardson Fund,	1,694.99	
" Charles Lewis Flint Fund,	24.56	
" Thomas Sherwin Fund,	12.50	
" Farnsworth Fund,	12.50	
" W. F. Huntington Fund,	22.39	
" Susan Upham Fund,	51.75	
" W. B. Rogers Fund (additional $85.00)	156.60	
Susan E. Dorr Fund (additional, $1,541.73)	1,646.05	
Rotch Architectural Fund	25,000.00	
Rotch Arch. Library "	5,000.00	
Arthur Rotch Prize "	5,000,00	
Arthur Rotch "Special" Prize Fund	5,000.00	
T. Sterry Hunt Fund	3,118.75	
Elisha Atkins "	5,197.92	
Nichols Fund	5,098.96	
		57,220.67
GIFTS AND BEQUESTS FOR GENERAL PURPOSES.		
Subscriptions of 1892 (additional)	7,500.00	
Catherine P. Perkins Legacy (additional)	7,500.00	
William J. Walker Legacy (additional)	10,598.73	
Katharine B. Lowell Fund	5,000.00	
William Perry Estate (additional)	500.00	
		31,098.73
SECURITIES SOLD OR PAID. GENERAL FUND, page 77		4,430.00
SUNDRIES.		
Income credited to Bond Premium Acc't	393.96	
Income credited to Rogers Bond Premium Acc't	400.00	
Boston Art Student's Asso. on acc't	666.67	1,460.63
		$435,182.69

MASSACHUSETTS INSTITUTE OF TECHNOLOGY.
FOR THE YEAR ENDING SEPTEMBER 30, 1895.

Cr.

Paid for Lowell Courses	6,000.00	
" " Charles Kastner's salary	2,500.00	
" " Expense Lowell School of Design	500.00	
		9,000.00
EXPENSES.		
Salaries, per Table (page 86)	203,641.87	
" paid from the Pope Fund	599.78	
Lecturers and Supplies paid from the Pope Fund	1,762.29	
Scholarships paid from Swett Fund	400.00	
" " " Savage "	800.00	
Repairs, per Table (page 87)	8,476.47	
General Expenses, per Table (page 87)	12,629.46	
Expenses on Boiler House	6,723.84	
Fuel	9,427.08	
Water	1,828.00	
Gas	2,159 80	
Printing and Advertising	2,590.48	
" Lecture Notes	2,620.66	
" Annual Catalogues and Reports	3,487.60	
Rents paid Boston & Albany R. R. Co.	180.00	
" " Natural History Society	200.00	
Laboratory Supplies and Libraries, per Table (page 86)	32,874.95	
Society of Arts	1,595.98	
Photographs and Casts, Rotch Fund	557.46	
Interest 4.75 per cent on funds not in stocks and bonds	5,191.38	
Interest paid A. Lowell, Trustee	1,000.00	
" " on Mortgage Notes	8,500.00	
		307,247.10
SECURITIES BOUGHT OR RECEIVED AS LEGACIES. GENERAL ACCOUNT.		
40 Shares The Molsons Bank, Montreal	3,000.00	
2,000 Burlington & Missouri R. R. 6s., exempt	2,310.00	
3,000 Illinois Central R. R. 4s.	3,053.58	
		8,363.58
PURCHASE OF SECURITIES WM. B. ROGERS MEMORIAL FUND.		
Scrip K. C. Memphis & Birmingham R. R.		66.40
SUNDRIES.		
Notes Payable	70,000.00	
Students' Deposits	50.00	
Pope Fund, 1894, used	1,162.07	
Scholarship Funds, 1894, used	657.17	
Letter-Box Fund, 1894, used	63.25	
Students' Notes	830.50	
Profit and Loss, per contra. (See page 78)	15,935.29	
		88,698.28
Cash balance, Sept. 30, 1895		21,807.33
		$435,182.69

The following account exhibits the property held by the Institute, as per Treasurer's books, Sept. 30, 1895 : —

INVESTMENT OF THE W. B. ROGERS MEMORIAL FUND.

$50,000.00	Saginaw & Western R. R. 6s.	1913	50,000.00	
30,000.00	Burlington & Mo. River R. R. 4s.	1910	25,787.50	
27,000.00	Kansas City Belt R. R. 6s.	1916	27,000.00	
16,000.00	Kansas City, Clinton & Springfield R. R. 5s.	1925	16,000.00	
7,000.00	Omaha & Southwestern R. R. 8s.	1896	7,000.00	
5,400.00	Republican Valley R. R. 6s.	1919	5,400.00	
4,000.00	Cin., Ind., St. Louis & Chicago R. R. 6s.	1920	4,000.00	
2,000.00	Ottawa, Oswego & Fox River R. R. 8s.	1900	2,000.00	
2,000.00	Kansas City, Fort Scott & Gulf R. R. 7s.	1908	2,000.00	
3,000.00	Kansas City, Memphis & Birmingham R. R.			
	1,000 General Mortgage 4s.	1934		
	2,000 Income 5s.	1934		
			2,221.40	
1,000.00	Lincoln & Northwestern R. R. 7s.	1910	1,000.00	
1,000.00	Atchinson & Nebraska R. R. 7s.	1908	1,000.00	
42,000.00	Chicago, Burlington & Quincy R. R. Conv. 5s.	1903	40,820.00	
35,000.00	Fort Street Union Depot 4½s.	1941	34,825.00	
24,000.00	Rome, Watertown & Ogdensburg R. R. 5s.	1922	24.000.00	
	Advances to Bond Premium account.		8,171.41	
	Bonds			251,225.31

INVESTMENT OF THE JOY SCHOLARSHIP FUND.

	Massachusetts Hospital Life Insurance Co.	5,000.00	
	Deposits in Savings Banks	3,555.83	
			8,555.83

INVESTMENT SWETT SCHOLARSHIP FUND.

	Massachusetts Hospital Life Insurance Co.	10,000.00

INVESTMENTS, GENERAL ACCOUNT.

$14,000.00	Bur. & Mo. River (Neb.) R. R. 6s. non-exempt	1918	14,000.00	
2,000.00	Bur. & Mo. River (Neb.) R. R. 6s. exempt	1918	2,000,00	
6,000.00	Chicago, Burlington & Quincy R. R. 4s.	1922	5,100.00	
3,000.00	Milwaukee & St. Paul R. R. 7 3-10	1898	3,000.00	
4,000.00	Chicago, Burlington & Northern R.R. 5s.	1926	4,000.00	
2,000.00	Kansas City, Fort Scott & Gulf R. R. 7s.	1908	2,000.00	
1,000.00	Union Pacific R. R. 6s.	1898	1,000.00	
3,000.00	Hannibal & St. Joseph R. R. 6s.	1911	3,000.00	
15,000.00	Chicago, Burlington & Quincy R. R. Conv. 5s.	1903	15,000.00	
6,000.00	West End Street Ry. 5s.	1902	6,000.00	
2,000.00	Brookline Gas Light Co. 5s.	1913	2,000.00	
35,000.00	Fitchburg R. R. 5s.	1903	35,000.00	
65,000.00	Boston & Maine R. R. 4½s.	1944	65,000.00	
26,000.00	Am. Dock & Improvement Co. 5s.	1921	26,000.00	
3,000.00	Illinois Central R. R. 4s.	1951	3,000.00	
	Advances to Bond Premium account		5.511.24	
	Bonds			191,611.24
	Amount carried up			$461,392.38

Amount brought up				461,392.38

STOCKS.

SHARES.					
148	Boston & Albany R. R.	par	100	29,933.00	
194	Morris & Essex R. R.	"	50	14,690.00	
40	New York & Harlem R. R.	"	50	5,000.00	
85	Pittsburg, Fort Wayne & C. R. R.	"	100	12,880.00	
12	Cocheco Manufacturing Co.	"	500	6,000.00	
56	Hamilton Woolen Co.	"	100	5,390.00	
59	Everett Mills	"	100	5,310.00	
31	Great Falls Manufacturing Co.	"	100	3,472.00	
6	Manchester Mills	"	100	660.00	
2	Dwight Manufacturing Co.	"	500	1,600.00	
1	Merrimack Manufacturing Co.	"	1000	1,015.00	
1	Laconia Co.	"	400	605.00	
2	Pepperell Manufacturing Co.	"	500	2,300.00	
10	Lowell Bleachery	"	100	975.00	
27	Essex Co.	"	50	4,050.00	
158	Pennsylvania Coal Co.	"	50	23,160.50	
15	Consolidated Gas Co., New York	"	100	1,447.50	
7	Lowell Gas Light Co.	"	100	1,610.00	
40	Cambridge Gas Light Co.	"	100	7,000.00	
7	Lawrence Gas Light Co.	"	100	882.00	
55	Old Boston National Bank	"	100	5,510.50	
15	Merchants' National Bank	"	100	2,220.00	
25	New England National Bank	"	100	3,875.00	
25	Atlantic National Bank	"	100	2,875.00	
10	National Union Bank	"	100	1,240.00	
25	National Bank of the Republic	"	100	3,625.00	
40	The Molsons Bank, Montreal	"	50	3,000.00	
					150,325.50

REAL ESTATE.

Rogers Building		200,000.00	
Walker "		150,000.00	
Land on Garrison Street	50,840.00		
Workshops " "	30,000.00		
		80,840.00	
Land on Trinity Place	76,315.69		
Engineering B'ld'g, Trinity Place	90,000.00		
		166,315.69	
Gymnasium Building		7,967.85	
Architects' "		57,857.10	
Lot No. 2 Trinity Place		137,241.60	
Clarendon St. Land and Building		142,762.94	
House No. 34 Commonwealth Ave.		30,000.00	
			972,985.18
Equipment, Engineering Building		16,555.24	
" Workshops		20,628.56	
			37,183.80

SUNDRIES.

Notes Receivable	1,500.00	
Boston Art Students' Association	13,666.66	
Students' Notes	3,733.00	
Cash Balance, Sept. 30, 1895	21,807.33	
		40,706.99
		$1,662,593.85

The foregoing Property represents the following Funds and Balances, and is answerable for the same.

The income of the following is used for the general purposes of the Institute:

William Barton Rogers Memorial Fund	250,225.00	
Richard Perkins Fund	50,000.00	
George Bucknam Dorr Fund	49,573.47	
Martha Ann Edwards "	30,000.00	
Nathaniel C. Nash "	10,000.00	
Sidney Bartlett "	10,000.00	
Robert E. Rogers "	7,680.77	
Albion K. P. Welch "	5,000.00	
Stanton Blake "	5,000.00	
McGregor "	2,500.00	
Katharine B. Lowell "	5,000.00	
		424,979.24

The income of the following is used towards paying salaries: —

Nathaniel Thayer, for Professorship of Physics	25,000.00	
Jas. Hayward, for Professorship of Engineering	18,800.00	
William P. Mason, " Geology	18,800.00	
Henry B. Rogers, for General Salaries	25,000.00	
		87,600.00

SCHOLARSHIP TRUSTS.

Richard Perkins Fund	52,857.69	
James Savage Fund	13,073.51	
Susan H. Swett Fund	10,182.95	
William Barton Rogers Fund	10,358.87	
Joy Fund	8,555.83	
Elisha Thacher Loring Fund	5,357.54	
Charles Lewis Flint Fund	5,278.49	
Thomas Sherwin Fund	5,012.50	
Farnsworth Fund	5,012.50	
James H. Mirrlees Fund	2,677.88	
William F. Huntington Fund	5,230.72	
Susan Upham Fund	1,141.12	
Susan E. Dorr Fund	2,557.56	
T. Sterry Hunt Fund	3,118.75	
Elisha Atkins Fund	5,197.92	
Nichols Fund	5,098.96	
		140,712.79

OTHER TRUSTS.

Charlotte Billings Richardson, Industrial Chemistry Fund	37,378.78
Charles Lewis Flint, Library Fund	5,000.00
Rotch Architectural Fund	25,000.00
Rotch Arch. Library Fund	5,000.00
Arthur Rotch Prize Fund	5,000.00
Arthur Rotch " Special " Prize Fund	5,000 00
Letter-Box Fund, balance	59.12

MISCELLANEOUS.

Notes Payable	150,000.00	
Students' Deposits	600.00	
Martha Ann Edwards Legacy, 1893	98,452.89	
T. O. H. P. Burnham " "	20,000.00	
Catherine P. Perkins " "	96,213.00	
William J. Walker " 1894	21,136.00	
M. I. T. Stock Account	540,462.03	
		926,863.92
		$1,662,593.85

Comparative Statement of Funds, etc.

	Sept. 29, 1894.	Sept. 30, 1895.
Trusts for general purposes	456,007.24	424,979.24
" " Salaries	87,600.00	87,600.00
" " Scholarships	125,844.28	140,712.79
" " Library	5,000.00	5,000.00
Charlotte B. Richardson Ind. Chem. Fund	35,683.79	37,378.78
Albert A. Pope Street Building and Highway Engineering Fund	1,162.07	
Letter-Box Fund	122.37	59.12
Notes Payable	220,000.00	150,000.00
Students' Deposits	650.00	600.00
Subscription of 1887	123,500.00	
" " 1892	121,250.00	
Martha Ann Edwards Legacy	98,452.89	98,452.89
T. O. H. P. Burnham "	20,000.00	20,000.00
Catherine P. Perkins "	88,713.00	96,213.00
William J. Walker "	10,537.27	21,136.00
Rotch Architectural Fund		25,000.00
Rotch Architectural Library Fund		5,000.00
Arthur Rotch Prize Fund		5,000 00
Arthur Rotch "Special" Prize Fund		5,000.00
M. I. T. Stock Account	473,167.20	540,462.03
	$1,867,690.11	$1,662,593.85
Increase		
Consisting of: —		
Bequests for Special Purposes, etc. See page 76		57,220.67
Gifts and Bequests for General Purposes. See page 76		31,098.73
		$88,319.40
Less Expenses more than income	15,935.29	
" Boiler House acct., 1894, charged off	25.20	
" Emery Testing Machine, charged off	10,000.00	
" Scholarship Funds, 1894, used	657.17	
" Letter-Box Fund, 1894, used	63.25	
" Pope Fund, 1894, used	1,162.07	
" Loss on Sale of Brookline Gas Co. Stock	270.00	
" Students' Deposits		28,112.98
" Notes Payable paid		50.00
		70,000.00
		98,162.98
In view of the greatly reduced valuation of the buildings, made by the Board of Underwriters, it has seemed best to make a large reduction in the valuation at which the buildings have been carried on our books, viz.:		
Rogers Building, reduced		115,726.88
Walker Building, "		40,492.44
Engineering Building, "		16,616.87
Workshops "		22,416.49
Total reduction		$195,252.68

INCOME FROM GENERAL INVESTMENTS, AND APPLICATION THEREOF.

Applied to Salaries	4,161.00	From Dividends, Bank Stocks	1,479.17
" " Scholarships	4,050.00	" State Tax returned on Bank Stocks	236.58
" " " James Savage Fund	592.83	" Bonds	9,123.92
" " Library	237.50	" Dividends, Railroad Stocks	2,678.00
" " General Purposes	9,853.82	" " Coal and Gas Stocks	1,910.00
" " Increase of Funds	2,556.94	" " Manufacturing Stocks	1,227.00
" " Advances to Bond Premiums	393.96	" Interest allowed on Funds not in Bonds and Stocks @ 4¾ %	5,191.38
	$21,846.05		$21,846.05

INCOME FROM WILLIAM BARTON ROGERS MEMORIAL FUND, AND APPLICATION THEREOF.

Paid Massachusetts Institute of Technology .	9,688.25	Received Income from Railroad Bonds . . .	10,088.25
Credited to Advances Bond Premiums . . .	400.00		
	$10,088.25		$10,088.25

DETAILS OF SOME ITEMS IN TREASURER'S CASH ACCOUNT.

Rents.

Huntington Hall, for Lowell Lectures		3,500.00	
Lowell School of Design		1,800.00	
Chauncy Hall School, for Gymnasium		500.00	
State Board of Health, for use of Laboratories		750.00	
Boston Water Works " " " "		66.67	
Land and Building, Clarendon St., on account		2,625.00	
34 Commonwealth Avenue, 1 year	2,200.00		
less Annuity under Will	1,000.00		
less Tax and Repairs	397 90		
	1,397.90		
		802.10	
Use of Rooms and Gymnasium		1,588.54	
			11,632.31

Department Supplies.

Chemistry	10,352.20	
Physics	5,242.46	
Mining	1,853.16	
Mechanical Engineering	2,561.57	
Naval Architecture	444.22	
Applied Mechanics	1,450.18	
Civil Engineering	2,878.12	
Biology	2,149.36	
Geology	666.13	
Architecture	1,593.32	
Drawing	32.16	
Mathematics	98.85	
English	980.93	
Workshops	1,252.37	
Modern Languages	185.19	
Periodicals	1,134.73	
		32,874.95

Salaries.

Instruction	168,026.12	
Administration	18,465.64	
Labor	17,150.11	
		$203,641.87

Repairs.

Department Improvements: —			
Chemistry	[illegible]		
Physics	[illegible]		
Mining	[illegible]		
Biology	[illegible]		
Workshops	[illegible]		
Architecture	[illegible]		
Civil Engineering	[illegible]		
Applied Mechanics	[illegible]		
English	[illegible]		
Mechanical Engineering	[illegible]		
Geology	[illegible]		
Drawing	[illegible]		
Mathematics	[illegible]		
Naval Architecture	[illegible]		
		[illegible]	
Sundries		[illegible]	
Steam Fitting		[illegible]	
Rogers Building		[illegible]	
Walker "		[illegible]	
Engineering Building		[illegible]	
Gymnasium "		[illegible]	
Architectural "		[illegible]	
Lowell School of Design		[illegible]	
Fowler, Tools, etc.		[illegible]	
General Library		[illegible]	
			[illegible]

General Expenses.

Fire Insurance		2442 76
Stationery and Office Supplies		1,401.07
Postage		1,347 00
Entrance Examinations		684.05
Washing		650.14
Sundries		600.36
Janitor's Supplies: Brushes, Pails, etc.		457.02
Diplomas, Commissions and Expense of Drill		441.50
Express Charges, Teaming, etc.		400.76
Paints, Varnish, etc.		371.04
Lowell School of Design		305.98
Books, Supplies, etc., for General Library		287.84
Furniture		205.63
Ice		240.53
Examination Books		225.10
Circular Saw for Workshops		223.37
Electric Lighting: —		
Power	342.00	
Wiring, etc.	545.68	
		887.77
Gymnasium Supplies		184.23
Card Case for Library		135 00
Amount carried forward		$11,080.85

Amount brought forward		11,686.85	
Military Dept.		115.00	
Window Shades		104.53	
Engine Room Supplies: —			
Oil	176.84		
Cotton Waste	18.72		
Sundries	33.23		
		228.79	
Telephone & Telegraph Co.		97.85	
Glass		96.88	
Type-Writing Machines		170.00	
Union Safe Deposit Vaults		50.00	
Fire Hose		40.56	
Safe, Sec'y's Office		20.00	
Legal Fees		19.00	
			$12,629.46

BOSTON, Nov. 29th, 1895.

An examination of the accounts of the Treasurer of the MASSACHUSETTS INSTITUTE OF TECHNOLOGY for the year ending Sept. 30, 1895, has been made, and they are found to be correctly cast, and with proper vouchers. The ledger balances agree with the trial balance. We have verified the evidences of personal property held by the Institute.

FREDERIC W. LINCOLN,
JAMES P. TOLMAN,
CHARLES C. JACKSON,
Auditing Committee.

MASSACHUSETTS

INSTITUTE OF TECHNOLOGY.

ANNUAL REPORT

OF THE

PRESIDENT AND TREASURER,

DECEMBER 9, 1896.

JOHN WILSON AND SON.
University Press, Cambridge.
1897.

Members of the Corporation.

President.

FRANCIS A. WALKER.

Secretary.[1]

FRANCIS H. WILLIAMS.

Treasurer.

GEORGE WIGGLESWORTH.

JOHN D. RUNKLE.	ARTHUR T. LYMAN.
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WILLIAM ENDICOTT, Jr.	THORNTON K. LOTHROP.
JOHN CUMMINGS.	CHARLES C. JACKSON.
AUGUSTUS LOWELL.	SAMUEL M. FELTON.
HOWARD A. CARSON.	DESMOND FITZGERALD.
CHARLES J. PAINE.	SAMUEL CABOT.
CHARLES FAIRCHILD.	FRANCIS BLAKE.
DAVID R. WHITNEY.	CHARLES W. HUBBARD.
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HENRY D. HYDE.	THOMAS L. LIVERMORE.
ALEXANDER S. WHEELER.	A. LAWRENCE ROTCH.
JAMES P. TOLMAN.	WILLIAM H. FORBES.
HOWARD STOCKTON.	JOHN R. FREEMAN.
ELIOT C. CLARKE.	GEORGE A. GARDNER.
NATHANIEL THAYER.	WILLIAM H. LINCOLN.
CHARLES F. CHOATE.	J. B. SEWALL.
HENRY L. PIERCE.	THOMAS GAFFIELD.
HIRAM F. MILLS.	CHARLES L. LOVERING.
PERCIVAL LOWELL.	A. LAWRENCE LOWELL.

On the Part of the Commonwealth.

His Excellency Gov. ROGER WOLCOTT.
Hon. WALBRIDGE A. FIELD, *Chief Justice of the Supreme Court.*
Hon. FRANK A. HILL, *Secretary of the Board of Education.*

[1] Communications should be addressed to the Secretary of the Institute.

Committees of the Corporation.

Executive Committee.

FRANCIS A. WALKER.
GEORGE WIGGLESWORTH. } *Ex Officiis.*

JOHN CUMMINGS. THOMAS L. LIVERMORE.
FRANCIS H. WILLIAMS. AUGUSTUS LOWELL.
ALEXANDER S. WHEELER.

Finance Committee.

WILLIAM ENDICOTT, Jr. CHARLES C. JACKSON.
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FREDERIC W. LINCOLN. FRANCIS A. WALKER.
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Visiting Committees.

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JOHN R. FREEMAN.

Departments of Mechanical Engineering and Applied Mechanics.

HIRAM F. MILLS. FRANCIS BLAKE.
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Department of Mining and Geology.

THOMAS L. LIVERMORE. JAMES P. TOLMAN.
CHARLES FAIRCHILD. CHARLES L. LOVERING.

Department of Architecture.

THORNTON K. LOTHROP. JOHN R. FREEMAN.
ELIOT C. CLARKE. A. LAWRENCE ROTCH.

Department of Physics and Electrical Engineering.

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A. LAWRENCE ROTCH.

Departments of Literature, History, and Political Economy.

FRANK A. HILL. CHARLES C. JACKSON.
J. B. SEWALL. A. LAWRENCE LOWELL.

Department of Modern Languages.

J. B. SEWALL. NATHANIEL THAYER.
FRANK A. HILL. THORNTON K. LOTHROP.

Department of Mathematics.

PERCIVAL LOWELL. HOWARD A. CARSON.
HOWARD STOCKTON. DESMOND FITZGERALD.

Departments of Chemistry and Biology.

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THOMAS GAFFIELD.

Department of Chemical Engineering.

ARTHUR T. LYMAN. SAMUEL CABOT.
HIRAM F. MILLS. CHARLES W. HUBBARD.

Department of Naval Architecture.

CHARLES J. PAINE. WILLIAM H. FORBES.
HOWARD STOCKTON. WILLIAM H. LINCOLN.

To the Corporation of the Massachusetts Institute of Technology:

The year upon which I am to report has been, in general, one of prosperity. The number of students has more than held its own, in spite of the hard times. Unusually large additions have been made to the plant of the Electrical and the Mechanical Engineering Departments. While the need of room has been felt more than ever before, this has been largely due to the development of the courses, the increase of machinery and apparatus, and the ever increasing specialization of the work of the higher years. It has not been loss but gain which has caused the degree of inconvenience and discomfort which has been experienced. This is the kind of hardship which it is easiest to put up with. At the same time, it must be said that it will not be possible for the school to continue long in the cramped condition into which it has been brought by its remarkable growth, without the beginnings of serious injury.

In the spring of the present year, it was for a time hoped that, in spite of the limited means at the disposal of the Corporation, a new building might afford relief to several overburdened departments, and provide for the growth of the school during a few years to come. So strongly did the Executive Committee entertain this belief that plans were prepared for a structure which should extend southward from the Architectural Building toward the Providence Railroad about one hundred and fifty feet, with a width of fifty-eight feet, and which should comprise four stories[1] and a basement, yielding an aggregate available floor space, after deduction of stairs and hallways, of about thirty-seven thousand square

[1] Since the Engineering and Architectural Buildings were erected, a change in the building laws of the city has reduced the number of stories which can be obtained in a structure of this type.

feet. Professors Chandler and Homer, and other members of the instructing staff of the Architectural Department, undertook, in a very public-spirited way, to make the plans, which were carried into every detail of construction upon a scale and in a manner which would allow the work to be immediately proceeded with. Unfortunately, the Executive Committee received legal advice that it was doubtful whether a certain amount of money which was to come to the Institute by bequest would be available for such a use. This unexpected complication arrested the efforts the Executive Committee were putting forth to get the matter into such a shape that they could bring it before the Corporation. An attempt was made to secure the funds by subscription; but the general condition of business and the feeling of those to whom the school would naturally turn for relief and assistance were such as to give no encouragement. The matter was accordingly dropped for the time. It will be the cause of deep regret if the friends of the school do not, at an early date, enable this hopeful project to be carried out.

Perhaps I cannot better show what are the present most pressing needs of the school than by briefly indicating the uses to which it was proposed to devote the new building. The departments which were especially to be benefited were Chemistry, Architecture, Biology, Mechanical Engineering, and Naval Architecture. In the basement, in addition to the heating and ventilating apparatus, was to be a large and well-equipped lecture room for General Chemistry. The room (No. 35) devoted to this purpose in the Walker Building has long been inadequate. Its seating capacity (200) has been so small as to require the lectures to the first year classes to be repeated. Again, this room is not high enough to allow the most effective seating of the students, with a view to enable each one to watch the professor's hand during experimentation. The new lecture room was to be large enough (52×52 ft.) to allow the whole class to be assembled at once, and high enough (17 ft. in the clear) to allow the best results in seating the students. To afford an unobstructed

view in this room, there were to be no central columns; and the weight of the four stories above was to be carried by a large steel girder, leaving a clear view of the professor's table. In addition to this large lecture room, the basement was to contain, besides the staircase and entrance hall, a modelling room (26 × 54 ft.) for the Architectural Department; a lecture room of the same dimensions; Professor Pope's office; a dressing room and elevator. A passage way was also provided for the use of teams carrying coal to the boiler-house in the rear.

The first floor, which was to be reached both by the present stairway of the Architectural Building and by a large staircase located at the centre of the new building, was to contain the Department of Biology. The need of increased space for this important and growing branch of the Institute has been set forth in several annual reports of the President. The technical applications of Biology have within recent years become of great industrial and commercial importance. This school has from the first taken the lead in instruction and in investigation in these lines; and it will be a matter of the deepest regret if Professor Sedgwick and his capable staff are not soon afforded an opportunity to carry on their work with every facility and advantage, instead of, as now, under conditions which not only restrict the scope of their work, but inevitably impair its quality. The plans for the biological laboratory, as worked out in conjunction by Professor Sedgwick and Professor Chandler, were ingenious and effective.

The portions of the second and third floors nearest the present Architectural Building, and connecting with its present rooms by the existing staircase and landings, were to be devoted to the enlargement of the Architectural Department. The effect of this change would be to bring all the architectural drawing-rooms upon two floors, instead of distributing them up and down throughout the whole height of a building, as at the present time. Each of the three upper classes of the department would thus be given a large drawing-room,

no student being separated from the library by more than one flight of stairs. The third floor of the present building would be devoted entirely to the library. This latter arrangement would not only provide for the future increase of the collections of books and photographs, but would permit a freedom in their use which is impossible under the present cramped conditions. Our architectural library is now a magnificent one; but the space afforded is not sufficient to allow the students to make the most of it, and on account of this lack of proper space the professors of the department cannot introduce some desired changes in the courses requiring the study of books and photographs. In addition to the provision thus to be made for ample drawing-rooms and for a largely increased use of the library, a feature of great importance was to be added. It is very necessary that opportunity be given for the study of full-size casts of classic architecture. To attain this end, a room, of the whole depth of the building and forty feet in length, was to be assigned to our museum of architectural appliances, models and designs; while, in order to get the proper effect of height, in placing the plaster casts of columns, friezes, and full-size ornaments, this room was to rise through the next story to the roof, the floor of the fourth story being left out through the entire width of the building and for a length of twenty-eight feet. In this way it would be possible to give the proper effect to the superb casts now coming into the possession of the department through the expenditure of the income of the Arthur Rotch fund. Of the portions of the third and fourth stories not occupied by the Architectural Department, it was proposed to reserve a part for certain important uses, such as a small gymnasium for the young women of the Institute, lecture, recitation rooms, etc., while another part was to be left vacant to allow of future expansion.

The fourth and uppermost story of the new building — with the exception of the space, twenty-eight feet by the depth of the building, cut out for the benefit of the Architectural museum, as before stated — was to be devoted to the

laboratory of General Chemistry. During the thirteen years since that laboratory was placed on the fourth floor of the Walker Building, our classes have increased to a degree which renders the accommodations provided scarcely adequate. In spite, however, of considerable inconvenience resulting from lack of room, the staff of the chemical department would still prefer to leave the laboratory of general chemistry in the Walker Building, were it not that the other branches of the department are in urgent need of additional accommodation, which the withdrawal of the laboratory and the lecture room of general chemistry would allow to be supplied.

Such was to be the new building of the Institute of Technology according to the plans of the Executive Committee, carefully wrought out in conference with the professors of the several departments, and put into definite form by the unwearying zeal of Professors Chandler and Homer, and their assistants. But it would not be possible to give an adequate idea of the advantages which would result to the school from this source without speaking of the uses it was proposed to make of the space that would be vacated in the existing buildings. The Architectural Department being concentrated upon two floors of the two buildings, the basement and the fourth floor of the present building would be vacated. In the basement it was proposed to afford opportunity for the expansion of Professor Lanza's superb laboratory of Applied Mechanics, now doing a work in the testing of materials and in engineering experimentation, which, it is believed, is nowhere paralleled. The fourth floor it was proposed to devote either entirely to the department of Naval Architecture, or jointly to the departments of Naval Architecture and Civil Engineering. The need of separate provision for the drawing-work of the former department, now carried on in the drawing-room of the mechanical engineers, and for the accumulation and proper disposition of models, blue prints, and other material, has been set forth in successive reports of the President. That need is constantly in-

creasing; and must soon be met if this useful and promising branch of our work is to have an adequate development. The first floor of the present Architectural building is devoted to recitation and lecture rooms; and these it was not proposed to disturb. The fifth and uppermost floor, which is at present devoted to life class-work, and to freehand and water-color drawing, it was proposed to continue in its present use.

Turning now to the Walker Building, let us inquire what could have been done there for the expansion of the Departments of Chemistry and Physics, at present occupying the whole of that building except the few rooms reserved for instruction in modern languages and mathematics. The withdrawal of general chemistry would have left the laboratory (90 × 40 ft.) on the Newbury Street side of the fourth story to be occupied by the laboratories of analytical chemistry and organic chemistry, each of which has outgrown its existing quarters; while the present lecture room of general chemistry would become available for uses which the Executive Committee did not deem it important to determine in advance. The needs of the two departments are so great that even the apportionment of this space would still leave much to be desired. This should not, however, make us indifferent to the measure of relief which would be afforded.

Turning now to the Rogers Building, I ask the attention of the Corporation to the great advantage, both scholarly, social, and sanitary, which the withdrawal of the Biological Department would afford. The laboratory now occupied by that department extends ninety feet across the whole width of the building on its Newbury Street end, and is thirty feet in depth; this it was proposed to make a general reading-room for the students of the Institute, with the Librarian's office at one end. Such a reading-room, especially if reached by new staircases at the rear of the building, above the present entrance into the basement, and warmed and lighted during the evening, for study or for quiet conversation, would constitute

an addition of inexpressible value to the present accommodations for our students. To many, the opportunity for passing their evenings in a large, well-lighted, well-furnished and well-ventilated room would not only facilitate their progress as scholars, but would afford a very valuable means of bringing them into better social relations than they now enjoy at the Institute. Such a room would also, upon occasion, be used for gatherings of students or for receptions by the President and members of the Faculty, and would constitute an important addition to our resources on commencement and other gala days. The present library would naturally become a much needed Faculty room.

Such was the pleasant dream in which the Executive Committee and the Faculty indulged themselves until rudely awakened by the impossibility of securing the necessary funds under the painful industrial and commercial conditions prevailing the past season. Is it too much to hope that those who have again and again come forward to the support of the Institute in its times of need and trial, will not long allow the school to suffer from accommodations so painfully cramped? I have here upon the table the plans which I have referred to as prepared by the Executive Committee last spring. It may interest the members of the Corporation to examine them; and any information which may be desired regarding the uses of the several portions of the building will be cheerfully given. I would say, in closing, that the Executive Committee received propositions from responsible builders which would have brought the entire cost of the building to about a hundred thousand dollars.

When it was at last reluctantly admitted that it was impossible to undertake the construction of a building which should be available for any part of the present school year, it became absolutely necessary to make a certain degree of provision for the Chemical Department. The situation was this: every desk in the laboratory of organic chemistry was occupied, while the in-coming fourth-year class was to be considerably larger. Many of the needs of the Institute were

urgent and pressing; but this seemed the most imperative. In consequence, all the changes made were to meet this single exigency. The William Ripley Nichols Chemical Library, which has for thirteen years been on the fourth floor of the Walker Building, was removed to Rooms 39 A and B, on the third floor. Here, the space formerly occupied by Dr. Drown for his private study and laboratory, and a part of the space occupied heretofore for molecular-weight determinations, was fitted up for a library. Not only are the present collections agreeably and conveniently placed here, with an effective installation of electric lights; but the additional room will provide for their normal increase through some years to come. A portion of the former room 39 A has been retained as a laboratory of molecular-weight determinations.

The space thus made vacant on the fourth floor has been utilized, through the removal of some partitions and the erection of others, for enlarging the laboratory of organic chemistry by the addition of eight students' desks, with convenient hoods and other fittings. The remainder has been divided into two laboratories, a small one for an instructor's use, and a larger one which will be occupied by Professor Noyes for organic and physical-chemical research.

The Graduating Class.

The school year of 1895–96 closed on the 9th of June, according to the new calendar of which I spoke in my last report. The graduating exercises will hereafter come always in June, the introduction of several holidays having the effect to bring commencement between the 3d and 11th of that month. The class of 1896 was the largest in the history of the school, numbering 188. Of these 25 graduated in Civil Engineering, 34 in Mechanical Engineering, 10 in Mining Engineering, 24 in Architecture, 16 in Chemistry, 48 in Electrical Engineering, 3 in Physics, 3 in Biology, 7 in Chemical Engineering, 4 in Sanitary Engineering, 3 in Geology, 5 in Naval Architecture, while 7 graduated from the

Department of General Studies. Of the Bachelors of 1895, three — Messrs. Frank Augustus Bourne, Herbert William Chamberlain, and George Defren — received the degree of Master of Science, on the completion of an additional year of successful study, the first two in Architecture, the last in Chemistry.

The Entering Class.

The registration of this year, as by the Catalogue now in press, amounts to 1,198 against 1,187 twelve months ago. It appears, therefore, that in the number of students this year the school has held its own.

Year.	No. of Students.	Year.	No. of Students.
1865–66	72	1881–82	302
1866–67	137	1882–83	368
1867–68	167	1883–84	443
1868–69	172	1884–85	579
1869–70	206	1885–86	609
1870–71	224	1886–87	637
1871–72	261	1887–88	720
1872–73	348	1888–89	827
1873–74	276	1889–90	909
1874–75	248	1890–91	937
1875–76	255	1891–92	1,011
1876–77	215	1892–93	1,060
1877–78	194	1893–94	1,157
1878–79	188	1894–95	1,183
1879–80	203	1895–96	1,187
1880–81	253	1896–97	1,198

Students by Classes.

The aggregate number of students for 1896–97 is divided among the several classes as follows: —

Graduate students, candidates for advanced degrees	11
Regular students, Fourth Year	194
" " Third "	198
" " Second "	182
" " First "	286
Special students	327
Total	1,198

Assigning the special students to classes, according to the predominant studies pursued by them, we reach the following division of the whole body among the several years: —

Class.	Regular.	Special.	Total.
Graduates of the M. I. T.	11		11
Fourth Year	194	64	258
Third Year	198	92	290
Second Year	182	125	307
First Year	286	46	332
Total	871	327	1,198

Statistics of Examinations.

Of the 1,198 students of the present year, 440 were not connected with the school in 1895–96. Of these, 263 were admitted as regular students of the first year upon the basis of their entrance examinations. The 177 remaining comprise (1) those who had previously been connected with the Institute, and have resumed their places in the school; (2) those who were admitted provisionally without examination; (3) those who were admitted by examination as special students; (4) those who were admitted on the presentation of diplomas or certificates from other institutions of college grade. In addition to the 263 who were thus admitted to the Institute on examination, and have taken their place in the school, 66 were admitted on examination, but have not entered the school. The number of this last class, always large, has this year been increased even over that of last year by the continued depression in business.

In the case of the 263 persons who were admitted on examination, and have joined the school, the results of the examinations, embracing both those of June and those of September, were as follows: —

Admitted clear	183
" on one condition	43
" on two conditions	23
" on more than two conditions	14
	263

Thirty-nine applicants were rejected.

Examinations at Distant Points.

In addition to the entrance examinations held at Boston in June and September, examinations were conducted in June at Albany, Atlanta, Buffalo, Chicago, Cincinnati, Cleveland, Detroit, Easthampton (Mass.), Exeter (N. H.), Lawrenceville (N. J.), Los Angeles, Louisville, New York, Philadelphia, Pittsburgh, Portland (Maine), Portland (Oregon), Pottstown (Pa.), St. Paul, Seattle, Washington.

Residence of Students.

States.	Candidates for Advanced Degrees.	Fourth Year.	Third Year.	Second Year.	First Year.	All Regular Students.	Special Students.	Total.
Alabama	..	..	..	..	1	1	..	1
Arkansas	..	..	..	..	1	1	..	1
California	..	1	3	1	1	6	3	9
Colorado	..	..	1	3	..	4	3	7
Connecticut	..	6	5	2	5	11	6	24
Delaware	..	1	..	1	1	3	2	5
Dist. of Columbia	..	..	3	2	6	11	6	17
Georgia	..	..	..	1	1	2	1	3
Idaho	..	..	..	1	..	1	..	1
Illinois	..	12	2	6	12	32	13	45
Indiana	..	..	..	1	1	2	1	3
Iowa	..	1	..	4	1	6	8	14
Kansas	..	..	2	..	..	2	1	3
Kentucky	..	3	2	3	2	10	2	12
Maine	..	3	4	5	8	20	7	27
Maryland	..	2	2	2	3	9	..	9
Massachusetts	11	119	130	106	179	545	185	730
Michigan	..	1	2	2	1	6	..	6
Minnesota	..	3	..	1	..	4	3	7
Missouri	..	1	..	2	4	7	4	11
Montana	..	..	..	..	1	1	2	3
Nebraska	..	..	1	..	..	1	1	2
New Hampshire	..	3	6	3	6	18	8	26
New Jersey	..	1	3	3	3	10	3	13
New York	..	12	13	7	15	47	22	69
North Carolina	..	..	..	..	1	1	..	1
Ohio	..	6	6	3	5	20	8	28
Oregon	..	..	..	1	2	3	1	4
Pennsylvania	..	7	4	6	12	29	13	42
Rhode Island	..	6	2	4	3	15	5	20
South Carolina	..	1	..	..	3	4	2	6
Tennessee	..	..	1	..	..	1	..	1
Texas	..	..	1	..	1	2	..	2
Utah	..	..	..	1	..	1	1	2
Vermont	..	1	..	2	2	5	2	7
Virginia	..	..	2	1	..	3	..	3
Washington	..	..	..	..	2	2	3	5
West Virginia	..	..	..	..	1	1	1	2
Wisconsin	..	..	1	1	1	3	3	6
Wyoming	..	..	..	..	..	..	1	1
Foreign Countries.								
Chile	..	..	..	..	..	..	1	1
Cuba	..	..	..	1	..	1	1	2
England	..	..	..	2	..	2	..	2
France	..	..	..	..	1	1	..	1
Japan	..	1	1	..	..	2	..	2
Mexico	..	..	..	1	..	1	2	3
New Brunswick	..	..	..	2	..	2	..	2
Nova Scotia	..	1	..	..	..	1	..	1
Ontario	..	2	..	..	..	2	..	2
Quebec	..	..	1	..	..	1	1	2
Turkey	..	..	..	1	..	1	..	1
Venezuela	..	..	..	..	..	..	1	1
Total	11	194	198	182	286	871	327	1198

Thirty-nine States of the Union, besides the District of Columbia, are represented on our list of students. Of the total number of 1,198, 730 are from Massachusetts, or 60.9 per cent. of the whole; 104 are from other New England States; 364 are from outside New England. Of these, 20 are from foreign countries..

A table showing the number of students in each year, from 1890, coming from each State or Territory, and from each foreign country, may not be without interest and instruction:—

	1890.	1891.	1892.	1893.	1894.	1895.	1896.
States.							
Alabama	..	2	4	2	1	..	1
Arkansas	3	3	2	1	..	..	1
California	14	19	14	15	9	8	9
Colorado	4	7	7	5	8	7	7
Connecticut	31	30	27	30	29	27	24
Delaware	1	..	2	4	3	5	5
Dist. of Columbia	7	4	4	7	12	16	17
Florida	3	3	4	3	2	1	..
Georgia	2	2	3	3	2	2	3
Idaho	..	1	1	1	..	1	1
Illinois	34	32	40	39	36	42	45
Indiana	6	3	5	6	3	2	3
Iowa	9	10	10	13	10	12	14
Kansas	2	2	1	1	4	4	3
Kentucky	4	8	7	11	12	11	12
Louisiana	8	5	2	3	3	2	..
Maine	29	27	39	36	38	38	27
Maryland	7	7	6	4	4	9	9
Massachusetts	517	565	603	665	707	721	730
Michigan	16	13	10	7	8	7	6
Minnesota	12	13	13	11	9	5	7
Missouri	8	12	13	17	14	9	11
Montana	1	..	..	2	2	1	3
Nebraska	1	1	4	3	4	2	2
Nevada	1	3	3	2	2	..	..
New Hampshire	23	24	29	32	27	30	26
New Jersey	11	16	11	6	5	5	13
New Mexico	..	1	2	2	1	1	..
New York	40	40	50	52	59	64	69
North Carolina	1	1	1	..	..	..	1
Ohio	33	33	39	45	50	37	28
Oregon	1	1	2	1	1	1	4
Pennsylvania	22	26	25	31	37	36	42
Rhode Island	21	26	24	33	25	21	20
South Carolina	2	4	1	3	3	5	6
South Dakota	..	..	..	..	..	..	..
Tennessee	3	4	1	1	1	1	1
Texas	1	2	5	6	6	3	2
Utah	..	..	1	2	2	5	2
Vermont	4	5	4	5	3	5	7
Virginia	5	6	4	3	2	5	3
Washington	2	3	3	1	3	1	5
West Virginia	2	2	2	1	1	3	2
Wisconsin	10	7	9	11	6	7	6
Wyoming	..	..	..	..	..	..	1
Foreign Countries.							
Argentine Rep.	2	..	..	..	..	..	..
Belgium	..	..	1	1	1	..	..
Brazil	2	4	..	..	1	1	..
Bulgaria	1	1	1	1	..	..	..
Central America	..	1	1	1	..	1	..
Chile	..	..	..	..	1	1	1
Colombia	..	2	..	..	..	..	..
Cuba	..	..	..	1	1	3	2
England	2	1	1	1	..	2	2
France	1	1	1	1	..	..	1
Germany	..	..	..	2	1	..	..
Guatemala	..	..	1	..	..	..	..
Hawaiian Islands	4	4	2	2	..	..	..
Holland	..	2	2	2	2	..	..
Ireland	1	..	..	1	1	..	..
Japan	4	3	1	1	1	2	2
Mexico	1	1	1	1	1	1	3
New Brunswick	1	2	1	1	1	1	2
New South Wales	..	1	1	1	1	1	..
Nova Scotia	2	1	..	..	1	2	1
Ontario	1	2	2	4	4	2	2
Peru	3	1	..	..	..	..	..
Porto Rico	2	1	..	1	1	1	..
Quebec	4	4	5	5	2	2	2
Scotland	3	2	1	2	1	..	..
Spain	..	..	1	1	1	1	...
Trinidad	1	1	..	..	..	..	..
Turkey	1	2	1	..	1	3	1
Venezuela	.	1	..	1	1	1	1
Total	937	1011	1060	1157	1183	1187	1198

Residence of Massachusetts Students.

It has been said that 60.9 per cent. of our students are from Massachusetts. All the counties of the State send students to the Institute. One hundred and twenty-two cities and towns are borne on the lists. The first column of the following table shows the number of cities and towns in each county sending pupils; the second column gives the aggregate number from each county. It appears that Suffolk sends two hundred and thirty-five, and Middlesex two hundred and twenty-five pupils; Essex comes third, with seventy-nine; Norfolk, fourth, with sixty-seven.

County.	No. of Towns.	No. of Students.	County.	No. of Towns.	No. of Students.
Barnstable . . .	5	7	Hampshire . . .	2	2
Berkshire . . .	6	13	Middlesex . . .	32	225
Bristol	6	33	Nantucket . . .	1	1
Dukes	1	1	Norfolk	15	67
Essex	21	79	Plymouth . . .	12	29
Franklin . . .	2	2	Suffolk	3	235
Hampden . . .	4	10	Worcester . . .	12	26
			Total	122	730

The following is a list of the towns, forty-two in number, which send four or more students to the Institute: —

Boston . . .	228	Waltham . .	9	Lawrence . .	5
Newton . .	44	Reading . .	8	Natick . . .	5
Cambridge .	30	Taunton . .	8	Springfield .	5
Brookline . .	21	Gloucester .	7	Wakefield .	5
Newburyport	20	Melrose . .	7	Watertown .	5
Somerville .	19	Worcester .	7	Wellesley . .	5
Malden . .	16	Chelsea . .	6	Woburn . .	5
Hyde Park .	14	Concord . .	6	Essex . . .	4
New Bedford	12	Framingham .	6	Mansfield . .	4
Lowell . . .	11	Weston . .	6	Milton . . .	4
Brockton . .	10	Arlington . .	5	Pittsfield . .	4
Lynn . . .	10	Belmont . .	5	Plymouth . .	4
Salem . . .	10	Fall River .	5	Randolph . .	4
Medford . .	9	Fitchburg . .	5	Winchester .	4

The following table exhibits for ten years the distribution of the total number of students among two classes: first,

those students whose names are found upon the Catalogue of the year preceding; and, secondly, those whose names appear upon the Catalogue of the year to which the statement relates.

Year.	(1) Total No. of Students.	(2) No. of Students in the Catalogue of the previous year who remain in the Institute.	(3) No. of New Students entering before issue of Catalogue.	(4) Of those in column (3) the following number are regular first-year Students.	(5) No. of New Students not of the regular first-year class.
1887–88	720	396	324	229	95
1888–89	827	465	362	245	117
1889–90	909	557	352	255	97
1890–91	937	572	365	234	131
1891–92	1,011	624	387	258	129
1892–93	1,060	618	442	303	139
1893–94	1,157	701	456	301	155
1894–95	1,183	768	415	271	144
1895–96	1,187	778	409	266	143
1896–97	1,198	758	440	263	177

Ages of Students on Entrance.

The next table exhibits the ages of our students upon entrance, after taking out those who are repeating the first year, and eleven persons of unusual ages. These deductions

Period of Life.	1895–6.		1896–7.	
	Half-year Groups.	Yearly Groups.	Half-year Groups.	Yearly Groups.
16 to 16½ years . . .	5	—	2	—
16½ to 17 " . . .	4	9	3	5
17 to 17½ " . . .	28	—	19	—
17½ to 18 " . . .	23	51	40	59
18 to 18½ " . . .	38	—	52	—
18½ to 19 " . . .	49	87	44	96
19 to 19½ " . . .	42	—	41	—
19½ to 20 " . . .	23	65	28	69
20 to 20½ " . . .	19	—	23	—
20½ to 21 " . . .	16	35	9	32
21 to 22 " . . .	11	11	11	11
	258	258	272	272

leave two hundred and seventy-two as the number of students whose ages have been made the subject of computation. The results appear in the table above in comparison with the corresponding results of 1895–96.

From the foregoing, it appears that the average age on entrance is eighteen years and eleven months.

In this connection I present the ages, at graduation, of the class leaving us in June. The one hundred and eighty-eight members of the class were distributed among the different periods of life as follows: —

Between	20	and	20½	2
"	20½	"	21	7
"	21	"	21½	11
"	21½	"	22	18
"	22	"	23	51
"	23	"	24	48
"	24 and over			51
Total				188

The special students this year constitute twenty-seven per cent of the whole body, as against twenty-eight per cent last year, and twenty-nine per cent the year before.

Graduates of Other Colleges.

The number of students who are graduates of this and other institutions is eighty. Of these, eleven are our own graduates, candidates for advanced degrees; sixty-nine are graduates of other institutions, pursuing courses of study with us, either as regular or as special students. Fourteen are graduates of Harvard University; five of Amherst College; four of Yale University; three each of Brown University, Georgetown University, Smith College, and Wellesley College; two each of Iowa State College, Johns Hopkins University, and Princeton University; while the following institutions are represented on our list by a single graduate each: Universities of California, Chicago, Michigan, Minnesota, Rochester, Santiago, Vermont; Cornell, Drake, Indianapolis,

and Norwich Universities; Boston, Carleton, Central Turkey, Colorado, Dartmouth, Dickinson, Hampden-Sidney, Middlebury, St. Johns, Trinity, Tufts, Williams Colleges; Colegio de Carreras; Throop Institute; U. S. Artillery School; and Virginia Polytechnic Institute.

The graduates of the Institute who are candidates for advanced degrees are Messrs. Charles William Berry, of the class of '95, the holder of the Swett Fellowship, in Physics, George Vincent Wendell, of the class of '92, the holder of the Savage Fellowship, in Physics, both studying abroad; Miss Margaret Eliot Dodd, of the class of '92, Mr. Simeon Curtis Keith, Jr., of. the class of '93, Mr. George Linder Bixby, of the class of '95, Messrs. Henry Cummings, Jr., Ralph Coolidge Henry, Herbert Edwards Smith, Albert Ernest Smyser, James Smith Smyser, William Henry Whitten, Jr., all of the class of '96. Of the seventy-one graduate students not candidates for advanced degrees thirty-two are regular students, — viz., twelve in the fourth year, thirteen in the third year, six in the second year, one in the first year. Of the thirty-one graduates who are regular students in the three upper classes, one takes both Mechanical and Electrical Engineering; one takes both Mechanical and Chemical Engineering; eight take Civil Engineering; two, Mechanical Engineering; one, Mining Engineering; five, Architecture; one, Chemistry; eleven, Electrical Engineering; and one, Chemical Engineering.

Women as Students at the Institute.

The number of women pursuing courses with us is seventy-one. Of these, eight are graduates of colleges. Of the total number, one is a candidate for an advanced degree; two are regular students of the fourth year; four, of the third year; five, of the second year; five, of the first year. Fifty-four are special students. Of the eleven regular students of the upper classes, four take Course IV., Architecture; three, Course V., Chemistry; two, Course VII., Biology; two, Course VIII., Physics. Of the special students, thirty-four devote them-

selves to Biology, eight to Chemistry, six to Architecture, two to General Studies, one to Physics, one to Geology, one to Mathematics, and one to Drawing.

The Courses of Instruction.

The following table presents the numbers of the regular students in the second, third, and fourth years, by courses.

Year.	Civil Engineering.	Mechanical Engineering.	Mining Engineering and Metallurgy.	Architecture.	Chemistry.	Electrical Engineering.	Biology.	Physics.	General Course.	Chemical Engineering.	Sanitary Engineering.	Geology.	Naval Architecture.	Total.
4th Year Class	29	41	7	18	22	40	2	4	7	13	4	..	8	194*
3d " "	31	46	8	28	22	34	2	5	4	7	3	..	9	198*
2d " "	39	36	9	19	22	32	3	2	..	14	1	..	8	182*
Total . .	99	123	24	65	66	106	7	11	11	34	8	0	25	574*

The following table shows the figures of the total line in the foregoing table, in comparison with the corresponding figures for the next ten preceding years: —

Year.	Civil Engineering.	Mechanical Engineering.	Mining Engineering and Metallurgy.	Architecture.	Chemistry.	Electrical Engineering.	Biology.	Physics.	General Course.	Chemical Engineering.	Sanitary Engineering.	Geology.	Naval Architecture.	Total.
1886 . . .	45	75	19	13	24	52	4	2	8	..	..	..	..	242
1887 . . .	50	89	16	18	23	61	5	6	14	..	..	..	..	282
1888 . . .	71	100	12	21	28	74	4	5	12	11	..	..	..	338
1889 . . .	79	99	14	30	29	91	9	5	12	14	6	..	..	388
1890 . . .	79	95	18	27	27	105	11	4	13	18	7	3	..	407
1891 . . .	81	104	17	33	23	108	11	5	19	28	9	3	..	441
1892 . . .	76	106	19	37	35	112	9	5	16	34	5	3	..	457
1893 . . .	78	97	22	50	39	141	4	10	19	31	10	2	8	511
1894 . . .	88	111	19	48	50	137	5	9	19	35	13	2	20	556*
1895 . . .	88	118	25	67	59	126	7	11	14	25	10	3	22	575
1896 . . .	99	117	24	65	66	106	7	11	11	34	8	..	25	573

* Deducting those counted twice.

The following table exhibits the number of persons who have graduated within each of the several courses at each succeeding year since the first diplomas were conferred:—

Year.	Civil Engineering.	Mechanical Engineering.	Mining Engineering.	Architecture.	Chemistry.	Metallurgy.	Electrical Engineering.	Natural History or Biology.	Physics.	General Course.	Chemical Engineering.	Sanitary Engineering.	Geology.	Naval Architecture.	Total.
1868	6	1	6	..	..	..	..	..	..	1	..	..	..	..	14
1869	2	2	..	..	1	..	..	..	..	..	..	..	..	..	5
1870	4	2	2	..	1	..	..	..	..	1	..	..	..	..	10
1871	8	2	5	..	2	..	..	..	..	..	..	..	..	..	17
1872	3	1	5	..	3	..	..	..	..	..	..	..	..	..	12
1873	12	2	3	1	7	..	..	..	..	1	..	..	..	..	26
1874	10	4	1	1	..	..	..	..	..	2	..	..	..	..	18
1875	10	6	6	1	1	..	..	..	1	2	..	..	..	..	27
1876	12	9	7	..	5	1	..	2	3	4	..	..	..	..	43
1877	12	6	8	4	2	..	..	..	..	..	..	..	..	..	32
1878	8	2	2	3	3	..	..	..	..	1	..	..	..	..	19
1879	6	8	3	1	3	..	..	1	1	..	..	..	..	..	23
1880	3	..	3	..	1	..	..	..	..	1	..	..	..	..	8
1881	3	5	6	3	8	..	..	1	..	2	..	..	..	..	28
1882	2	5	5	3	6	..	..	1	1	1	..	..	..	..	24
1883	3	7	5	1	3	..	..	..	..	..	..	..	..	..	19
1884	5	6	13	..	12	..	..	..	..	..	..	..	..	..	36
1885	4	6	8	2	4	..	2	..	..	1	..	..	..	..	27
1886	9	23	7	1	7	..	10	1	..	1	..	..	..	..	59
1887	10	17	8	1	9	..	8	1	1	3	..	..	..	..	58
1888	11	25	4	5	10	..	17	3	1	1	..	..	..	..	77
1889	15	23	5	3	8	..	17	1	1	2	..	..	..	..	75
1890	25	27	3	5	13	..	18	3	2	6	..	..	..	..	102
1891	18	26	4	6	11	..	23	3	3	1	7	..	1	..	103
1892	22	26	4	13	7	..	36	6	1	7	4	6	1	..	133
1893	25	30	5	2	8	..	41	2	..	6	8	..	2	..	129
1894	21	31	4	14	11	..	33	1	3	5	12	3	..	..	138
1895	25	30	3	15	14	..	33	..	2	4	11	4	..	5	144*
1896	25	34	10	24	16	..	48	3	3	7	7	4	3	5	188*
Total	319	366	145	109	176	1	286	29	23	60	49	17	7	10	1,594
Deduct names counted twice															10
Net total															1,584

* Deducting names counted twice.

The following table shows, by classes and by courses, the number of regular students who have registered themselves

as electing to distribute the required studies and exercises over the period of five years.

Year.	Total.	Course.												
		I.	II.	III.	IV.	V.	VI.	VII.	VIII.	IX.	X.	XI.	XII.	XIII.
1st . .	3	..	..	..	..	..	..	..	..	..	..	..	..	..
2d . .	10	4	1	..	1	1	2	..	..	..	..	..	..	1
3d . .	11	2	4	1	1	1	..	..	1	..	..	..	..	1
4th . .	12	..	2	..	1	..	7	..	1	..	..	..	..	1
5th . .	6	..	..	1	..	1	1	..	1	1	..	..	..	1
	42	6	7	2	3	3	10	..	3	1	..	..	..	4

Classification of Special Students.

Our special students can, of course, not be classified systematically; but the following table exhibits the number of such students pursuing each particular branch of study: —

Applied Mechanics . . .	65	History	78
Architecture	55	Language	161
Biology	51	Mathematics	162
Chemistry	127	Mechanical Engineering .	79
Civil Engineering . . .	39	Mining Engineering . .	11
Drawing	157	Physics	145
Electrical Engineering . .	30	Political Science	69
English	104	Shopwork	75
Geology	27		

The following is the number of students, either regular or special, pursuing certain leading branches of study, in each of the four years, as follows: —

	First Year.	Second Year.	Third Year.	Fourth Year.	Total.
Mathematics . . .	336	237	131	64	768
Chemistry	382	81	67	63	593
English	306	256	12	13	587
French	192	75	57	7	331
Physics	..	265	236	170	671
German	73	197	151	3	424
Shopwork	19	115	67	72	273

The most noticeable feature of the foregoing tables is the large falling-off in the number of students taking mathematics, especially in the third and fourth years. Last year the total number of students in this department was 881; this year it is only 768. Last year the number of students of the third and fourth years together taking mathematics was 285; this year it is only 195. The chief reason for this is found in the increased requirements in mathematics, at entrance. I ought to add that, while there has thus been a reduction in the total number of students taking mathematics, owing to the increase in entrance requirements, the number of students taking advanced mathematics has steadily advanced during the few years; and still further progress may be anticipated. In the other departments named, the number of students holds its own, as in the case of the modern languages, or shows an increase, as in the case of chemistry, physics, or shop-work.

Changes in the Faculty and the Corps of Instruction.

The year has fortunately passed without the loss of any member of the Faculty from any cause. Professor Holman's health most unfortunately remains such as wholly to incapacitate him for work with his classes. The affliction which has been so heroically borne by this ripe scholar and gifted teacher is a source of sorrow to all his associates in the Faculty and in the corps of instruction, as it must be to all his former pupils and his many friends. Even infirmity and confinement have not sufficed to fetter his masterly hand; and the last two years of sickness and pain have witnessed the preparation of several important professional treatises.

Within the Faculty several promotions have been made. The following associate professors have been raised to the rank of full professors, namely: Peter Schwamb, S.B., to be Professor of Mechanism and Director of the Workshops; C. Frank Allen, S.B., to be Professor of Railroad Engineer-

ing; Alfred E. Burton, S.B., to be Professor of Topographical Engineering; Dwight Porter, Ph.B., to be Professor of Hydraulic Engineering. Assistant Professor Linus Faunce, S.B., has been promoted to Associate Professor of Drawing. The Faculty has been reinforced by the following promotions from the corps of instructors, namely: George H. Barton, S.B., to be Assistant Professor of Geology; William H. Lawrence, S.B., to be Assistant Professor of Architecture; Arthur G. Robbins, S.B., to be Assistant Professor of Highway Engineering; Joseph J. Skinner, Ph.D., to be Assistant Professor of Mathematics.

The following is the academic and professional history of the several members of the Faculty who have received promotions during the year and of the new instructors appointed:

Professor Allen was graduated from the Institute in 1872 in Civil Engineering. For five years he was engaged in the active practice of his profession, on the Water Works and Sewerage of Providence, R. I., the Water Works of Newton, and the Sewerage of Boston. He then went west, and for ten years was occupied in various capacities on the Atchison, Topeka and Santa Fé Railway in Kansas, Colorado, and New Mexico, and was for a time in the employ of the Mexican Central Railway. He also engaged in some private practice during this period, and was for a time Chief Engineer of the Las Vegas (N. Mex.) Water Works. In 1887 he returned to Boston to accept the position of Assistant Professor of Railroad Engineering at the Institute, and in 1889 was made Associate Professor. Professor Allen is a member of the American Society of Civil Engineers, a Director of the Massachusetts Highway Association, and Secretary of the Society for the Promotion of Engineering Education, besides being a member of other scientific bodies.

Professor Peter Schwamb was graduated in 1878 from the Institute of Technology in the department of Mechanical Engineering. In 1879 he was draughtsman for the Howe Scale Co., Rutland, Vt.; from 1880 to 1883, draughtsman for the Hinck-

ley Locomotive Co., Boston. In 1883 he became Instructor in Mechanical Engineering in the Institute of Technology; from 1884 to 1888 he was Assistant Professor of Mechanism; in 1888 he was appointed Associate Professor of Mechanism. He has been Director of the Workshops since 1883.

Professor Burton was graduated from the Civil Engineering Department of Bowdoin College in 1878, and for a year or more thereafter practised as a land surveyor in Maine. In 1879 he entered the service of the Coast Survey, where he remained for three years, first as topographical draughtsman, and then as topographer. In 1882 he accepted the position of Instructor in Civil Engineering at the Institute. In 1884 he was made Assistant Professor, and in 1889 Associate Professor of Topographical Engineering. Professor Burton was in 1895 appointed by Governor Greenhalge a member of the Massachusetts Topographical Survey Commission, a position which he still holds.

Professor Porter was graduated from the Sheffield Scientific School of Yale University in 1880, and at once entered the service of the government as an expert in the water power investigation of the Tenth Census. He was engaged upon this work for four years, and published numerous reports on the Hydrography and Water Power of various portions of the country. He came to the Institute in 1883, and served for a short time as Instructor in Mathematics, but later became Instructor in Civil Engineering. In 1887 he was appointed Assistant Professor of Hydraulic and Sanitary Engineering, and in 1890 Associate Professor. Professor Porter has delivered lectures on sanitary subjects at the Pratt Institute of Brooklyn and at the School of Sociology at Hartford, and, in addition to his work at the Institute, has been consulted as an expert in a great variety of matters relating to Hydraulic and Sanitary Engineering, among which may be mentioned the investigation of the sanitary condition of tenement houses in Boston, which he undertook in 1886, and the question of damming the Charles River, which came up so prominently last year. Professor Porter is a member of the American

Society of Civil Engineers, as well as of various other technical associations.

Professor Faunce, a graduate of the Institute in 1877, and subsequently engaged in the engineering department of the New York & New England Railroad, was appointed Assistant Professor of Drawing in 1884, and placed in charge of the drawing of the first-year, and of the second-year Descriptive Geometry.

Professor Robbins was graduated from the Institute in 1886, and has since that time been engaged continuously in teaching, first as Assistant, and then as Instructor in Civil Engineering. For several years past he has had charge, under the general direction of Professor Allen, of the instruction in Highway Engineering.

Professor Barton was graduated in the department of Mining Engineering and Geology in 1880. After spending a year as Assistant in Drawing, he went to the Hawaiian Islands as Assistant on the Government Survey, where he remained two years. He was then called to return to the Institute as Assistant in Geology, and, while occupying this position, devoted his time to work in Mineralogy, Structural Geology, and Blowpipe Analysis. In 1886 he was appointed Instructor in Determinative Mineralogy; in 1892 Instructor in Geology. He has given the instruction in the Blowpipe Laboratory and in Micro-Lithology, and has taught Structural Geology to the students in the department of Civil Engineering. For nine years he has given lecture-room and field instruction in Mineralogy or Geology to large classes in the "Teachers' School of Science" of the Boston Society of Natural History. He has also extended his studies of geologic phenomena by travel, and by his original investigations when employed by the United States Geological Survey. During the past summer he was a member of the party which made a special study of the glaciers and other features of the Umanak district in Greenland.

Professor Lawrence was graduated from the Institute in 1891, and was at once made Instructor in Architecture. His

active interest, the accuracy of his work, and his ability as a teacher have been highly appreciated.

Dr. Skinner, a graduate of the Sheffield Scientific School of New Haven, was appointed Instructor in Mathematics in 1885.

While no vacancy has occurred in the Faculty of the Institute, the corps of instructors has lost one of its oldest members, — Mr. James Hugh Stanwood, for eight years Assistant or Instructor in Civil Engineering, who died May 24th last, after a lingering illness. Mr. Stanwood was born in 1860 in Brunswick, Maine, and after receiving his earlier education in the public schools of Portland, entered in 1879 the office of Edward C. Jordan, at Portland, where he was engaged for over a year. He was afterwards in the office of the City Engineer of Portland, in the employ of the Maine Central Railroad and in other engineering work. He entered the Institute in 1883, and graduated four years later, having worked during the summer vacations with the Maine Central Railroad. Immediately after graduating, he entered the office of the Philadelphia Bridge Works, where he remained for over a year as Assistant to the Designing Engineer. In 1888 he returned to the Institute, where he has since remained. Mr. Stanwood was extremely faithful in the discharge of his duties, and his associates and former students remember him with affection and respect.

Mr. Henry Nash Dickinson, who has been Instructor in English at the Institute from 1891 to 1896, has resigned to engage in secondary teaching at Norfolk, Conn. Mr. Edward Robinson, of the class of '91, formerly Instructor in Mechanical Drawing and Descriptive Geometry, has accepted an appointment for similar work at the new Clarkson School of Technology, Potsdam, N. Y. Mr. Simeon C. Keith, Jr., of the class of '93, is now occupied with various commercial interests connected with Bacteriology, but is continuing his studies as a candidate for the Master's degree. Mr. Joseph P. Lyon, Instructor in Civil Engineering, has resigned during the year, to enter professional practice. Mr. Henry E.

Crampton, Instructor in Biology, has also terminated his connection with the Institute, receiving an appointment as University Fellow at Columbia University.

The following gentlemen, Assistants of last year in the several departments named, have been appointed Instructors: George B. Haven, S.B., '94, and Alexander W. Moseley, S.B., '91, in Mechanical Engineering; Frank P. McKibben, S.B., '94, in Civil Engineering; James F. Norris, Ph.D., in Organic Chemistry; Joseph W. Phelan, S.B., '94, in General Chemistry; Samuel C. Prescott, S.B., '94, in Biology. William J. Drisko, S.B., '95, in Physics; Arthur W. Weysse, Harvard A.B., '91, A.M., '92, Ph.D., '94, has been appointed Instructor in Biology. He studied in 1894–95 at the Universities of Leipsic and Berlin; in 1895–96 at Paris and in the Zoölogical Station at Naples. He has been Assistant in Zoölogy at Radcliffe and in Botany at Harvard, and has published several papers on zoölogical subjects.

The following named Assistants have been appointed for the current year: Reuben E. Bakenhus, S.B., '96, Minor S. Jameson, S.B., '96, Charles M. Spofford, S.B., '93, and Harold C. Stevens, S.B., '96, in Civil Engineering; Amadeus W. Grabau, S.B., '96, in Geology; Leonard H. Goodhue, S.B., '96, in Analytical Chemistry; Harrison W. Hayward, S.B., '96, in Industrial Chemistry; Albert J. Wells, S.B., '96, in Mechanical Drawing; Edward M. Bragg, S.B., '96, and Frank B. Masters, S.B., '95, in Mechanical Engineering; William L. Root, S.B., '96, in Oil and Gas Analysis; George K. Burgess, S.B., '96, William D. Coolidge, S.B., '96, and Ralph R. Lawrence, S.B., '95, in Physics; Clarence W. Perley, S.B., '96, in Biology.

Statistics of the Corps of Instructors.

The Catalogue of 1896–97 shows the number of instructors of all grades to be one hundred and twenty-seven, inclusive of those concerned with the mechanic arts, but exclusive of those who are announced as lecturers for the year only. The addi-

tion of these raises the total to one hundred and fifty-three. The following table shows the distribution among the several classes of instructors, in comparison with last year: —

	1895–96	1896–97
Professors	19	23
Associate Professors	10	7
Assistant Professors	18	21
Instructors	53	52
Assistants	21	24
Lecturers	26	26
Total	147	153

The Library.

The accessions during the year were 4,433, which may be classified as follows: —

By purchase	1,647
" binding	580
" gift	2,206
Total	4,433

After deducting from the above the number of books, pamphlets, etc., reported lost, worn out, or removed from the shelves for other causes, the net accessions during the year are found to amount to 4,411. The following table shows the net accessions of books, pamphlets, and maps to each of the libraries of the Institute, together with the cost of those purchased by the departments. The table also shows the total number of volumes, and of pamphlets and maps taken together, in each library, September 30, 1896. To a certain extent the pamphlets are counted twice, for, according to the custom established in previous reports, a collection of pamphlets bound together in one volume is counted as one in the enumeration of the volumes, while at the same time each pamphlet in the volume is counted as one in the list of pamphlets.

TABLE SHOWING THE NET ACCESSIONS FOR THE YEAR 1895–96, WITH THE COST OF THE SAME AND THE TOTAL CONTENTS OF THE LIBRARIES OF THE INSTITUTE ON SEPTEMBER 30, 1896.

LIBRARIES.	Vols. added.	Pamph. added.	Maps added.	Cost (Dept.)	Total Vols.	Total Pamph. and Maps.
General	422	277		$ 340.44	4,654	3,112
Engineering	621	90	329	1,023.53	6,671	3,121
Mining	168	28		180.38	1,686	303
Architectural	232	10		294.61	1,879	181
Chemical	336	51		450.66	6,565	1,437
Biological	134	20		201.38	1,802	351
Physical	587	24		643.24	5,385	656
Economics and History	616	132	6	619.45	7,973	2.975
English	170			160.42	2,184	36
Geological	94	20	37	103.90	1,667	761
Margaret Cheney Room	7				575	13
Totals	3,387	652	372	$4,018.01	41,041	12.946

The above table shows that at the end of the academic year there was a total of 41,041 volumes in the libraries, and that there were also 12,946 pamphlets and maps, making a grand total of 53,947.

During the year there were 1,178 orders sent out for the purchase of books. Ninety orders were returned to heads of departments as duplicates; of these five were reordered; 1122 volumes were bound; 412 stamped on the back with the shelf number and the initials of the Institute. The total cost of binding was $1,263.42. To the main catalogue 2,561 cards have been added, and a slightly larger number, in the aggregate, to the catalogues of the departmental libraries. The total number of cards now in the main catalogue is 37,432.

Two hundred and thirty-nine books were received for inspection, of which ninety-nine were purchased. It has not been possible to keep a record of the number of books borrowed, except in the Chemical Library, and from this one there were taken out for use at home more than 1,030 books during the nine months from January 1st to September 30th.

The Institute has been so fortunate as to receive during the year gifts amounting to 2,206 books, pamphlets, and maps. Among the most noteworthy of these may be mentioned, — thirteen volumes by bequest from the estate of the late S. R. Urbino, including Brehm's Thierleben, six volumes; a complete set of the Encyclopedie-Roret, 143 volumes, from Mr. George L. Roberts; from the U. S. Coast and Geodetic Survey, 252 charts, completing our set; 119 volumes of architectural books from Mrs. Henry Draper, including Van Ysendyck, Documents Classés de l'Art dans les Pays-Bas, five volumes; Histoire de l'Art pendant la Renaissance en Italie, three volumes; Dieulafoy, L'Art Antique de la Perse, five volumes; Havard, La France Artistique et Monumentale six volumes; Gotch, Architecture of the Renaissance in England, two volumes; the first twelve volumes of the Architectural Association Sketch-book; and Van Stegmann and Geymüller, Die Architektur der Renaissance in Toscana, a beautiful work, of which thirty-six parts have been issued.

The assistants in charge of the Chemical and Physical Libraries have been instructed during the year by the Librarian in the art of cataloguing books; and they now write all the catalogue cards for their respective libraries. This plan was found to be so successful and to increase so much the general efficiency of the library service, that it is being extended to the Engineering Library. The Librarian is still obliged, however, to write the catalogue cards for the other eight libraries of the Institute, besides doing an immense amount of other purely clerical and more or less mechanical work, from which it is desirable that he should be relieved as soon as arrangements to that end can be made.

Advanced Degrees.

During the past year, a measure which it is believed will have important scholarly results has been adopted by the Faculty after long and careful consideration. The situation out of which the new procedure arose may be illustrated as follows: A young man has graduated from the Institute, let us say, in Mechanical Engineering. His scholarly ambitions and his financial means concur to induce him to remain for an additional year of study. Should his plans embrace systematic, advanced work in the course from which he has graduated, as would be likely to be the case with a graduate in Chemistry or in Architecture, for example, he would naturally become a candidate for the degree of Master of Science. But it has been found in our experience that the larger proportion of the not large number of students thus able and desirous to pursue additional studies at the Institute, prefer to take the work belonging to some other course more or less closely allied to that from which they graduated. For example, a student having finished the Mechanical or Chemical Engineering course is likely to choose work in Electrical Engineering, to constitute at least the greater part of his additional year's work. Under the former rules of the Faculty, he might, at the end of a year of successful study, receive, not the Master's degree, but the Bachelor's degree in his new department. By the new rule it is rendered possible for a graduate in one department, subject to conditions established for the purpose of guarding the scholarly character of the higher degree, to obtain, not a second Bachelor's degree, but the degree of Master, while pursuing work mainly in another department from that in which he graduated. There is still required, however, in general a certain amount of strictly advanced work; while the thesis presented is expected to be of a higher order than would be exacted in the case of a first degree.

The consideration which chiefly moved the Faculty to make this important modification of the pre-existing require-

ments for the Master's degree was that a student who had successfully completed any one of the thorough courses of study at the Institute, and had taken his Bachelor's degree, would, as a matter of course, take up and carry on the fourth year's undergraduate work of another department in a stronger and more masterly way than would have been possible but for his previous training and preparation, and his maturer age. In other words, though the subjects studied in the additional year are to a considerable degree under-graduate studies to the men of that course, they become, in a certain and high sense, graduate studies to the graduate student, by reason of his superior age and qualifications. Certainly, no one can question that a man who has taken an additional year of study and has handsomely completed two courses at the Institute is a riper scholar and a better equipped professional man than if he had only completed a single course. Why, then, should he not receive an acknowledgment of this addition to his scholarly character and standing?

While for the foregoing reasons the requirements for the Master's degree are made more liberal than heretofore, the conditions imposed are, it is believed, such as will protect the degree against any tendencies to a real lowering of the standard. I am happy to be able to add that the more liberal provisions governing this matter have already resulted in a considerable increase in the number of applications for the Master's degree.

Double Degrees.

Another matter of much scholarly interest which has been dealt with by the Faculty during the past year, has been the question of students receiving the Bachelor's degree in two departments at the same time. This has been done, and the degrees conferred accordingly. But, while the Faculty are not disposed to take the position that in some cases this may not be done to the advantage of the student, they yet feel that there is danger of abuse arising from this source.

Since it is naturally regarded as a feather in a man's cap to take two degrees at once, there will always be some ground to fear that a student may attempt this, not for the sake of a larger knowledge and a broader culture, but for the distinction attending it, with the result either that he may fail in both courses, or, what is more probable, that he will get through all the studies and exercises of both courses, but without doing any part of the work very well. It does not need to be said that it is far better for a young man to take one course in a masterly way than to take two in a somewhat halting fashion, even though the actual requirements for the degree be met. At the same time, the Faculty are aware that cases occur where a student can do two courses at once and do them thoroughly; and even that the two may mutually support and supplement each other.

Under the foregoing circumstances, it seemed to the Faculty desirable to take the matter up for systematic regulation. The amendment of the Faculty rules which has been adopted is the result of much consideration given to this subject, and will, it is believed, prevent students from undertaking a double course unless the reasons therefor shall, in their individual cases, be strong and clear. The rule now reads as follows: —

"An applicant for the degree of Bachelor of Science in two courses at the same time must have made application for such candidacy not later than November 1st, next preceding his graduation. Such application shall be referred to a special committee of the Faculty to report as to the eligibility of the candidate, and, in case his application is approved, to have the oversight of all of his work for the remainder of the year, and to report to the Faculty, at the close of each term, as to the character of the work done. The committee shall decide as to the time and manner of carrying on the thesis-work required, and may in special cases recommend that the candidate be allowed to conduct the two theses at the same time."

SCHOLARSHIPS.

The scholarship resources of the Institute have been considerably enlarged. It will be remembered that the grant, in 1895, of $25,000 per year, for six years, by the General Court of Massachusetts, was accompanied by a special appropriation for ten free scholarships for six years, supplementing the twenty scholarships established by the Act of 1887. The demand for these scholarships had been so great that, without any initiative on the part of the Institute, an act was passed at the session of 1896, establishing forty permanent State scholarships, in place of the arrangement, in part permanent and in part temporary, stated above. Every senatorial district in the State is now permanently entitled to representation in the Institute; and it is hoped that the few districts which at present send no applicants may avail themselves of the benefits of this provision of the Commonwealth. By the will of Mrs. Ann White Vose, the Institute has received for the aid of needy and deserving students a sum amounting to about $50,000. Scholarship awards for the present year have amounted to nearly $14,000; and still it has hardly been possible to provide even for the urgent cases.

By the generosity and kindly interest of Mr. Charles H. Dalton, long a member and once Treasurer of the Institute of Technology, a fund of $5,000 has been established for the endowment of a graduate scholarship in Chemistry, the income to be used for the payment of fees of American male students, graduates of the Institute, who may wish to pursue advanced chemical study and research, especially applicable to textile industries.

In memory of the late William Hall Kerr, of the class of 1883, his widow, formerly, as Miss Alice M. Getchell, a special student at the Institute, has established a fund of $2,000, the income to be applied to the maintenance of a special library of machine design.

The Technology Club.

While the matter is not one which officially comes within the cognizance of the Corporation, I know the members will be glad to learn, if they have not been previously advised, of the formation of a social club, to be known as The Technology Club, constituted of such members of the Corporation, the Faculty and the corps of instructors, and of such past students of the Institute as may desire to join, together with a certain number of students elected from the several classes, and especially from the upper classes. The organization of the club was due to a feeling, long entertained, that opportunities for social intercourse, and for conference regarding matters of interest to the school, should, in some way, be provided. After full discussion the enterprise was launched last spring; Mr. James P. Munroe, long the Secretary of the Institute, was elected President; the house No. 71 Newbury St., directly opposite the vacant space between the Rogers Building and the Natural History Building, was rented for a term of years and fitted up simply but pleasantly for social uses. At the beginning of the present school year, the Club was opened, and has now been in full operation for nearly three months, apparently with the highest success, notwithstanding the fact that the fees are exceptionally low. Those who have charge of its fortunes have shown as much prudence as energy. They are thoroughly devoted to the interests of the Institute; and they are bent on making the Club a force for good in the development of the school.

Official Advisers.

In a previous report, I referred to the system of advisers to new students which had been adopted by the Faculty, not with any view to appointing guardians for the young men, or to taking any degree of responsibility whatever for their conduct and deportment, but simply as a means of introducing each student coming for the first time to the school to some

member of the Faculty or instructing staff who would hold himself under obligation to afford such information and advice as might be asked. As was stated in my former reference to this subject, it was not expected or desired that this system should amount to a very great deal. It could not do this without interfering with that responsibility for their own lives, that accountability as ordinary citizens of the community, which has been a fundamental principle in the government of the Institute. But it was believed when this step was taken that the appointment of official advisers, for the limited objects in view, would be useful and helpful to many new students, and that this advantage would be increased as the advisers assigned to the duty should have larger experience in dealing with young men in this way. These expectations have been justified by the result. There have been no drawbacks to the operation of this system, and its whole effect has been for good. It is believed that the influence upon the students of the school has been not inconsiderable.

The Y. M. C. Association.

I am happy to say that still further efforts are being made for the purpose of assisting the student, on newly coming to the Institute, to order his life in Boston to the best advantage; and, also, to improve the general social character of the school. The Young Men's Christian Association of the Institute has especially directed its energies to the first mentioned object. The Association issues a small manual, containing much information useful to the new-comer. It has recently, for the second time, held its annual reception for new students, whether of the first-year class or not, an occasion of much interest and doubtless of real practical influence for good. The present year the Association has made the important advance of taking an ordinary dwelling-house at the South End and making it a club-house, most of the rooms being occupied by the officers and other members of the Association, as their ordinary living-rooms, while the

public rooms are freely open to students. This certainly shows a most commendable spirit on the part of the young men concerned, who have as good an opportunity as they could possibly desire to exert an excellent influence upon the social life of the school. I do not see why several such centres of benevolent activity may not in time be established in different parts of the city where our students most congregate. One additional direction of effort by the Young Men's Christian Association is specially worthy of notice. This is the attempt to secure pleasant and wholesome homes for newcomers. The officers and the committees of the Association have taken a great deal of pains to secure information as to houses into which students may be introduced to the greatest advantage, and this information is freely communicated to all who care to avail themselves of it.

The Institute was represented at the annual meeting in Washington of the Association of American Agricultural Colleges and Experiment Stations by Professors Allen and Tyler. The principal matter affecting the interests of the Institute was the proposed establishment of Engineering Experiment Stations, corresponding to the Agricultural Experiment Stations established in 1887. The Faculty accepted the invitation of the College of New Jersey to send a delegate to the celebration of its one hundred and fiftieth anniversary, in October of the present year. The Institute was represented by the President on that very interesting occasion when the College of New Jersey became Princeton University.

Entrance Requirements.

Four years ago, the Catalogue contained the statement that the Faculty were considering the expediency of making a further advance in entrance requirements and that it was probable such a step would be taken at no distant date. This announcement was made for the purpose of giving the preparatory schools fair notice and enabling them to consider

the question with due deliberation. At the present time, the Faculty have the matter under active discussion; but no definite conclusion has been reached. Inasmuch as the question of entrance examinations is one which is at present undergoing very active agitation, and as the Institute of Technology has been somewhat misrepresented in the course of discussion, it seems to me desirable to state just what our position is upon this matter.

The arguments in favor of an advance in the entrance requirements are strong. It is unquestionable that we should do our work better if our students came to us with the amount of preparation contemplated, and that the high schools of the land ought to be so organized and officered that they could give this instruction without difficulty and without further delaying the preparation of their pupils for college. Just here, in the last point mentioned, lies the main difficulty and perplexity of the subject. Important as the Faculty of the Institute consider the additional preparation to be, they will be entirely unwilling to ask it, if, after much discussion and conference with the secondary schools, it shall appear that the effect of such increased requirements would be to increase appreciably the age of our students at entrance. That age, which is now about eighteen years and eight or nine months, is fully as high as is considered to be for the best scholarly development of the pupils. Such an average means that a large number enter at an age considerably greater.

Further to increase the average age on entrance, or further to procrastinate the entrance of men above the average age, would, in the opinion of the Faculty, be distinctly and highly objectionable. They believe that students should not be held back in the secondary schools after they have reached the degree of maturity necessary for taking our work, even if it be to give them still further high-school preparation. The average boy of nineteen years has outgrown the spirit of the secondary school. If compelled to stay longer, his mental growth is retarded or possibly encounters a permanent check. The pupil who is held back to finish his high-school course

until he is twenty, is probably not more but less fortunate than one who comes to us at eighteen, even with a somewhat less complete preparation. When a certain period has been reached, youth, with its pliability and adaptability, is of more value to a student of this school, at least, than a certain amount of additional knowledge and the mental training involved in the acquisition of that knowledge.

The question, therefore, whether the advance in entrance requirements at the Institute which has so long been under consideration shall soon be adopted, depends mainly upon the answer to the question whether the preparatory schools can so deal with the matter as to send us pupils, equally well trained and equipped in other respects, who shall bring with them the additional preparation required, at an age not appreciably greater than that of to-day. This is not on its face impossible. Better and higher results can often be reached without any greater strain and in no longer time, simply by a better arrangement and systematization of work; by omitting traditional topics which are of no real importance; and by reapportioning the time to be expended upon the different parts of a subject. To our inquiries many of the preparatory schools have returned cordial and encouraging answers. Their desire is to make the advance which has been suggested. On the other hand, it is necessary that we should proceed with great caution in the interest of less fortunate schools, which, with a smaller staff of teachers and fewer resources, have all they can do at present to meet our requirements. To demand of them more may mean either a mere cramming for our examination, which we should deprecate, or the introduction of an intermediate year at some academy or distant high school. This last would involve an expense which many students would not be able to bear, and would be, on many other accounts, far from desirable.

ENGLISH.

A new departure has been taken by the English Department in the matter of the teaching of composition. There

are students who have elsewhere covered the first-year requirements in rhetoric, or have even succeeded in passing the examinations at the Institute, yet who have serious faults in the mechanics of writing. To aid these men in overcoming their defects, and to insure that no graduate shall be unable to write clear and correct business English, the department has undertaken the special individual supervision of these students. The experiment is being tried of calling to account men who are noticeably unable to spell or to write with reasonable correctness, and of insisting that effort be made to correct these faults. In connection with this, the chemistry notebooks of first-year students are examined weekly by the English Department to secure their being written with care and accuracy. By the coöperation of the instructors of the Department of Architecture, arrangements have also been made to have the papers of these students criticised for the English. It may be added that the increasing responsiveness of students to the work in literature is especially gratifying, and can hardly fail to lead to increased efficiency in all the work of the English Department. The work has been taken up with very great zeal by Professor Bates and his accomplished assistants. The amount of labor which they have brought upon themselves has been very great; and I trust that the financial condition of the school will soon permit of a reinforcement of the staff in English, so that every student of the Institute may receive no inconsiderable amount of individual attention from the instructors in this department.

Mathematics. — Still further changes in the arrangement of the work of the Mathematical Department have resulted from the advance in entrance requirements, which took effect in 1894, and which has now enabled the class of '98 to complete integral calculus during its second year. The time thus set free in the first term of the third year has been used in part for differential equations. Students in Electrical Engineering now complete this subject in the first term of the third year, instead of in the final term of their course, as heretofore.

The students in Mechanical Engineering, Chemical Engineering, and Naval Architecture take a brief course in differential equations, of particular value for their subsequent work in mechanics. An elective course was given last year by Dr. Woods on the theory of functions, and has been succeeded this year by a course on the theory of surfaces, open to advanced students and members of the instructing staff. The resources of the department have been much enlarged by the purchase of models. The collection is now ample for our own needs, and is of great value for certain branches of advanced work. Professors Woods and Bailey have in preparation a text-book on analytic geometry which will be used by the first-year class during the second term.

Modern Languages. — The work of the Modern Language Department has been carried on by Professor van Daell and his associates during the past year successfully, but without any notable change, yet with that degree of progress which comes from continuous attention and experience. In one direction, however, the modern language work of the Institute shows a very gratifying gain. I shall, in the following pages, call attention to several instances where important departments of the school are giving their students of the upper classes considerable practice in the reading of journals and scientific papers in French and German. This has always been done as far as the time and strength of the instructing staff would allow; but the later developments of the school have allowed it to be carried on during the past two or three years to a much larger extent. Nothing could be more desirable, and I trust to be able to report further progress another year.

Military Science and Tactics. — The instruction in Military Science, both theoretical and practical, has been carried on most fortunately during the year, under the able and judicious direction of Captain Bigelow. The recent improvement in this service has been truly remarkable. The spirit of the department has steadily risen, the instruction has constantly

become more scientific, while the practical results, as seen in the armory drill, are better than ever before. In truth, Captain Bigelow's two years of service here have made a distinct contribution to the subject of military instruction in colleges, by demonstrating that, even with a closely limited amount of time devoted to a course, sound, substantial results, worthy to be compared with the best results of instruction in mathematics, in philosophy or natural science, in history or the classics, can be obtained through the full utilization of the resources available, and a judicious and energetic direction of the work. The number of students of the first year regularly belonging to the battalion is exactly three hundred. In addition to these, four students receive the theoretical instruction in Military Science without the drill, having been excused from the latter on examination. One student is taking the drill as an option, making the total number of students in the department three hundred and five. In the examination held for candidates for appointment to the grade of officer in the battalion, twenty schools were represented, and two organizations of the National Guard, one in Illinois and one in New Jersey. The total number of students offering themselves for examination was thirty-five. All but one or two were new students at the Institute.

History and Political Science. — In History, a constantly increasing use is made of specially prepared maps, charts, diagrams, etc., in all the courses. This is true to a very large extent in the subjects taken by all the students of the first and second years. To the preparation of such material Professor Currier and Mr. Sumner have given a great deal of attention; and the resources of the department have been very greatly increased thereby. Maps, charts, and diagrams of appropriate sizes are now available for the illustration of every subject covered in the several courses; and these are so placed in cases, constructed especially for the purpose, that they are readily available for use.

By every means, the instructors in this department are

striving to make the work in history more and more fruitful. It has long been one of the highly approved features of the Massachusetts Institute of Technology that its courses combine some measure of philosophical studies with the predominant scientific and technical exercises of the school. In this matter, the Institute has been a leader among the scientific and technical schools of our country; and this feature is one which, while it cannot be greatly extended in the time given to it, may yet be truly magnified through the improvement and enlargement of the courses thus given. I have great satisfaction in feeling that our work in history is being done in the most admirable spirit and with a high degree of intelligence. A very interesting suggestion has been made that it might be found possible to establish relations between this department of the Institute of Technology and the teachers of history in the schools of Boston and vicinity through which the latter might be enabled, by no undue effort or sacrifice of time, to pursue courses of study here, not merely in history but in the related subjects of economics, statistics, sociology, and government. That the teaching of history in our grammar and high schools greatly needs enrichment and inspiration will be readily admitted by all. Whether the Institute could in any important degree contribute to this branch of instruction, is a matter to which thought will be given in the immediate future.

The work in Political Economy for all the students of the third year is being better systematized by the publication of a weekly syllabus; there is, moreover, a constantly increasing oversight of the written work of the students as carried on throughout the term.

Shopwork. — As it is some years since I have made more than a passing allusion to our shops, it seems appropriate to state just where we stand in this matter at the present time. No great changes have taken place; but under the enlightened direction of Professor Schwamb there has been a steady movement towards larger and better work. The members of the Corporation are aware that our shops have, from the first,

been of the character of laboratories. The exercises taking place in them are intended to be as purely and as highly educational as those in the laboratory of chemistry or physics. In each of the shop courses the student completes, from working drawings, a systematic series of "pieces," or models, designed to cover progressively the principles to be taught and to give practice in the use of the different tools or machines. So far as practicable, the models are useful objects; but in no case is the prime, I may even say, the sole object of the course, namely, instruction, sacrificed or subordinated to considerations of immediate utility. Our shops are not factories, but laboratories. It is not the thing made, but the training, the discipline, the practice, which the student obtains in the making, which forms the object in view.

Seven shop courses are recognized upon our schedules, namely, carpentry and wood-turning, pattern-work, foundry-work, forging, chipping and filing, metal-turning, machine-tool work. Of these, the course in foundry-work is purely optional, not being required as an essential part of any course. It is, however, taken by a considerable class. The course in metal-turning is specially arranged for students in electrical and chemical engineering. The instruction is in light lathe-work, on iron and on brass.

The equipment of the several departments of the shops is as follows: The carpentry, wood-turning, and pattern-making departments contain forty carpenters' benches, two circular-saw benches, a swing-saw, two jig-saws, a buzz-planer, a mortising machine, thirty-six wood-lathes, a large pattern-maker's lathe, and thirty-six pattern-makers' benches. The foundry contains a cupola furnace, two brass furnaces, a core oven, and thirty-two moulders' benches. The forge-shop contains thirty-two forges, seven blacksmiths' vises, and one blacksmith's hand-drill. The machine-shop contains twenty-three engine-lathes, seventeen hand-lathes fitted with slide-rests, two machine-drills, three planers, a shaping-machine, two universal milling-machines, furnished with spiral and gear-cutting attachments, a universal grinding-machine, a cutter

and reamer-grinder, a twenty-four-inch standard measuring-machine, thirty-two vise-benches arranged for instruction in bench-work, and a fully equipped tool-room. A power-hammer will be added to the equipment of the forge-shop during this year.

The number of students who can be accommodated at a time in each class is as follows: carpentry, forty; wood-turning and pattern-making, thirty-six; foundry-work, thirty-two; forging and chipping and filing, thirty-two; machine-tool work, twenty-three when all students are upon lathe-work, thirty when their work can be varied.

The following table gives the total number of hours allotted to the different shopwork subjects: —

Subject.	Mechan. Eng.	Elect. Eng.	Physics.	Chemical Eng.	Naval Architect.	Special Class.
Carpentry and Wood Turning	60	60	60	60	..	135
Pattern Work	30	..	..	..	..	90
Foundry Work	30	..	..	..	..	45
Forging	110	..	..	45	110	135
Chipping and Filing	70	..	..	..	70	60
Metal Turning	...	30	..	30	..	..
Machine-Tool Work	150	..	..	..	120	120

The following table shows the number of students taking the different shopwork courses during the past three years, with the corresponding numbers for 1896–97 estimated on the basis of the first term's registration: —

Subject.	1893–94.	1894–95.	1895–96.	1896–97.
Carpentry and Wood Turning	138	133	124	138
Pattern Work	55	72	68	90
Foundry Work	28	36	38	40
Forging	85	66	78	110
Chipping and Filing	58	54	60	69
Metal Turning	96	59	61	66
Machine-Tool Work	49	52	48	59

Students taking chipping and filing are only counted in the third year's part of the course.

In addition to the foregoing, there is a special class comprising five professional teachers taking the course in pattern-work.

Summer Schools.

Mining. — The Summer School of Mining was held this year among the iron mines of Michigan, Wisconsin, and Minnesota. Visits to mines and to furnaces occur on alternate years. This was the year for the mines. The party consisted of Professors Richards and Hofman and ten students. The students were from the second, third, and fourth-year classes of the Mining Department. Through the generosity of Messrs. M. A. Hanna & Co., of Cleveland, the members of the party were transported upon the ore-boats of the Company from Ashtabula, Ohio, to Escanaba, Michigan, one of the ports of the iron mines, and back again. The work of inspection and study began at Ironwood, in the Gogebic district, with the great Norrie mine, after which followed the Aurora, the Tilden, and the Newport mines. The party next visited, in the Mesabi Range, the Mountain Iron mine, the Oliver, the Norman, and the Franklin mines. On the return by way of Duluth, the great ore docks were inspected. Finally the Chapin, the Pewabic, and the Aragon mines of the Menominee Range were visited. The students found a great deal of interest in these remarkable iron districts, not only in the geology of the deposits, which has been a great puzzle to the geologists, but in the mining methods which have been brought to their present state of perfection by close competition and by the use of the highest engineering skill. The students and professors met with the kindest reception everywhere.

Geodesy, Topography, and Hydraulic Engineering. — The Summer School for field work in Geodesy, Topography and Hydraulics, was held during the month of June at Machias, Maine, a new locality for this work. The instruction was in

charge of Professors Burton, Porter, and Robbins, assisted by Mr. H. K. Barrows, Assistant in Civil Engineering, and Mr. G. C. Whipple, a graduate from this department, and one of the inventors of the thermophone, referred to in my last report. Fourteen members of the third-year class were in attendance. A base-line was measured with the one hundred-meter tape, using the thermophone for the determination of the precise temperature of the tape. This work was similar to that of last summer, and the results were equally satisfactory. A system of triangulation was extended over the country in the vicinity of Machias, and connected with the triangulation points of the United States Coast Survey. A topographical survey of about two square miles was made with the plane table, on a scale of 1 to 5,000, with contours ten feet apart. Plane table surveys were also made of the river front, on scales of 1 to 1,000 and 1 to 10,000, with special reference to a study of the water-power. A feature of field instruction, which was introduced for the first time this year, was the study of tidal phenomena and the determination of a datum plane for elevations. Machias furnishes an excellent opportunity for the study of the tides, the range being over fifteen feet. A special form of tide gauge was devised by Professor Robbins for the work, and the plotted results prove the excellence of the design. The hydraulic work consisted in measurements of the flow of the Machias River, by floats and by meters, at a point a short distance above the village of Machias. The stream at this place is about one hundred and forty feet wide, and from twelve to fourteen feet deep. The flow through one of the mill flumes was also measured, using the current meters and the Darcy tube. The School was in every respect satisfactory and profitable. It will probably be carried on at the same place next year.

Architecture. — During the past year the department of Architecture has made an important extension of its work, taking the initiative by sending a group of its students abroad for the study of European architecture. Since 1893, when the first summer school was held at Chicago, the

serious study of the Colonial buildings of New England has given the classes opportunities for an intimate acquaintance with the peculiarities of our local architecture. The work thus conducted has been valuable; but it could not be expected to afford the student the broad knowledge of style which forms so important a part of thorough architectural training. The scheme of a tour in Europe was at once supported by the students with enthusiasm. Although a fee was necessarily charged, twenty students from the third and fourth years applied for admission. Applications from several students of other colleges had to be refused, in order to keep the school down to a practicable size. The class of twenty students, in charge of Professor Homer, who had as assistant Mr. F. M. Mann, S.M., '94, spent fifty days in England and France, touring on bicycles from London to Southampton, and through Normandy and Touraine to Paris. It was found that this way of travelling was particularly advantageous, as it did away with railway expenses, was entirely healthful, and afforded unusual opportunities for the study of local architecture. The large size of the class required careful preliminary arrangements. Maps were imported, routes decided upon, and hotel accommodations secured, before the expedition left America. General permission to photograph and draw was also obtained from the French government. The only difficulties encountered were those that arose from accidents to bicycles, and the temporary fatigue produced by the method of travelling, but nothing of a serious nature occurred at any time. The tour proved entirely successful, the eleven days in England and the thirty-nine days in France giving excellent opportunities for comparing examples of monumental and domestic architecture of the Romanesque, Gothic, and Renaissance styles of these countries. Pencil sketches and studies were made in each town visited, and a large number of photographs taken with the twelve cameras carried by instructors and students. The average necessary expense for the entire trip of seventy-six days proved to be $340.00. Omitting London and Paris, the

average necessary expense was $2.00 per day for England, and $1.90 for France. It is to be hoped that this successful precedent in the study of European architecture will be followed with good results in succeeding years.

Geology. — No summer school in Geology was held the past year, but during the semi-annual vacation the students in economic geology, under the guidance of Professor Crosby, made a ten days' excursion to Washington and the mining districts of eastern Pennsylvania. In Washington, attention was given chiefly to the important economic collections in the National Museum. The other points where special studies were made included the anthracite coal mines at Drifton, Pa., the slate quarries at Slatington, and the zinc and steel works at Bethlehem. Very profitable visits were also made to the Delaware Water Gap and the Cavern of Luray.

Summer Courses at the Institute.

The system of Summer Courses on which I have commented in the last two annual reports, has again been carried on in certain subjects, after the completion of the school year. The courses have generally lasted for five or six weeks, covering about the ground of the regular instruction of the year in the same subjects. A special committee of the Faculty under the chairmanship of Professor Crafts has had general charge of the arrangements. It has been previously remarked that only a considerable amount of experience in such a matter could enable us to decide whether this scheme would meet a real want. The experience of the last summer, in addition to that already acquired, seems to show that the courses offered have been, in number and variety, somewhat in excess of the needs of students, actual or prospective. At the same time, the attendance upon certain courses holds on well, and seems to indicate that these, at least, should be continued. The more successful courses of the present year were those in analytic geometry, analytical chemistry, organic analysis

and preparations, physical measurements, and machine-tool work.

Courses I. and XI., Civil and Sanitary Engineering. — No changes of importance have been made in the courses of study during the past year. During the coming year, 1897–98, some rearrangement of the work of the fourth year will be required, resulting from the transfer to the third year of the course in applied mechanics, hitherto given in the fourth year.

I have already spoken of the loss of the Civil Engineering Department through the death of Mr. Stanwood and the resignation of Mr. Lyon; Mr. H. K. Barrows, Assistant last year, also resigned to enter professional practice. The places thus left vacant have been filled, and one additional Assistant has been appointed, in view of the large increase in the work of the department.

In my last report, I referred to the desirability of our having a small building erected on firm ground in the neighboring country, equipped with the necessary means for pendulum and magnetic observations and for the ordinary observations of field astronomy. The funds required for the erection of such a building having been granted by the Corporation, the building will be erected and partially equipped during the present year, as soon as a suitable site can be secured. Our facilities for instruction in the line of geodesy and practical astronomy will thereby be greatly improved, and it is hoped that the means for properly equipping this building will soon be forthcoming.

Mention should here be made of the fact that during the past summer Professor Burton, on the invitation of Lieutenant R. E. Peary, U. S. N., organized a party for scientific research in western Greenland. The party comprised Professors Burton and Barton, and Mr. R. W. Porter, from the Institute of Technology, Mr. G. R. Putnam, Assistant in the U. S. Coast and Geodetic Survey, and Messrs. J. C. Phillips and A. M. Dodge, students in Harvard University. Starting early in July, this party was taken in Lieutenant Peary's steamer

"Hope" to Umanak Fjord, Greenland, where it was left for five weeks, while Lieutenant Peary proceeded farther north, calling for the party on his return. The most important results of this expedition are the measurements of glacial motion and temperature and the study of glacial action, by Professors Burton and Barton, and the pendulum and magnetic measurements made by Mr. Putnam, who was specially detailed by the U. S. Coast and Geodetic Survey to accompany this expedition. The party was in every way successful, meeting with no mishaps, and the results will prove of value to science.

The equipment of the department has been increased in various ways during the past year. A collection of twenty-six levels and eight transits was purchased from the Mexican Central Railway Co., some of which will be disposed of, while the remainder, when put in good condition, will render it unnecessary for the department to purchase for the use of students any further instruments of this character for a long time to come. Two mercurial barometers have also been procured for use in the summer school. In the hydraulic laboratory a new measuring-tank has been procured, six feet in diameter and ten feet high, a duplicate of the one already in use, giving greatly increased facilities for the accurate measurement of considerable volumes of water in experimental work. The introduction of this tank required considerable changes in piping, chutes, and valves, for directing and controlling the flow of water. Valuable experiments were made last year, as a part of the thesis work of students, with apparatus specially planned for the purpose, in determining the effect of irregular connections and on the loss of head at sudden enlargements of pipes. For the convenient use of the present hydraulic apparatus, it is important that there should be an enlargement of the reservoir in the concrete floor, to which all water discharged in experiments is conducted, and from which it is pumped, being thus used repeatedly. It is also desirable that we should have increased pumping facilities, and arrangements have just been made for procuring a powerful rotary pump.

Mention should also be made of the fact that in the instruction of the Civil Engineering Department the use of lantern slides is being gradually introduced. During the past year over seven hundred slides were procured for use in various courses, principally relating to bridges and railroads. The only additional set of notes prepared by the instructors of this department during the past year is a new edition of Professor Porter's Notes on Stereotomy, for the use of the third-year students. Excursions have been made to several manufacturing establishments and other places of interest; and thanks are due to President Tuttle, of the Boston & Maine Railroad, W. H. Barnes, General Manager of the Boston & Albany Railroad, President C. P. Clark and General Superintendent E. G. Allen, of the New York, New Haven & Hartford Railroad, for courtesies extended to the classes. The department has also received during the past year a large number of blue-prints of various engineering works from city engineers, bridge companies, and other friends of the Institute.

In the present year there are forty students in the fourth year of the Courses in Civil and Sanitary Engineering; and the drawing-room is crowded to its utmost capacity. Four of these students are pursuing the Course in Sanitary Engineering and thirty-six that in Civil Engineering. Of the latter, twenty have elected the first, or general option, fifteen the second, or railroad option, and one, a special student, the third, or geodetic option.

Course II., Mechanical Engineering. — The following apparatus has been added to the laboratory, viz.: —

1. An Otto gas-engine of thirty-six horse-power capacity, with all the latest improvements.

2. An unusually complete and delicate apparatus for testing steam injectors, which was built and in service during the latter part of the last school year.

3. In place of the compound Marsh pump, of a capacity of eight hundred gallons per minute, which was loaned to the laboratory, and has now been returned to the makers,

a rotary pump has been added, of a capacity of one thousand gallons per minute, made by the Holyoke Machine Company.

4. A Buckeye steam-engine governor, arranged for experimental purposes.

5. A Rider hot-air engine has been presented to the laboratory by Mr. Fred A. Wilson, of the class of '91.

During the last school year, in the regular laboratory work, complete tests have been made of two large plants: one a fifty-hour test of the West End Street Railway Power Station at Sullivan Square, Charlestown, and one, another twenty-four-hour duty test of the triple engine of the Chestnut Hill Pumping Station.

The detailed results of the test of the latter plant made in May, 1895, by the students under the direction of Professor Miller, were published in No. IV. of the "Results of Tests made in the Engineering Laboratories," this being contained in the "Technology Quaterly" dated June–September, 1896. The results of other tests made in the Mechanical Engineering laboratory during the school year 1895–96, will appear in No. VI. of the "Results of Tests made in the Engineering Laboratories," contained in the "Technology Quarterly" for December, 1896.

There is great need of additional space, both in the laboratory and in the other rooms of the department.

This year, for the first time, the changes due to the increased requirements of admission affect the third-year class, and advantage has been taken of that fact to make a number of improvements in the course. Those which affect the third year, and which, therefore, take effect this year, are the following: —

1. A short course in elementary differential equations has been added.

2. A course has been added in industrial electricity and in electrical measurements.

3. Political economy is to be completed in the third year, instead of a portion being left for the fourth year, as heretofore.

4. A little additional time has been given to the third-year course in applied mechanics.

The following publications have been made by members of the department: —

1. A treatise on steam-boilers (now in press), by Professors Peabody and Miller.

2. A new edition of the "Notes on Dynamometers, Planimeters, Governors, and Fly-wheels," by Professor Lanza, has been printed.

It should also be noted that, during the last year, Professor Schwamb has been in charge of an extensive investigation of a matter of great public interest, on behalf of the Steam Users' Association.

APPLIED MECHANICS. — The following apparatus has been added to the laboratory; viz: —

1. An Olsen testing-machine, of one hundred thousand pounds' capacity, for tensile and compressive tests, capable of testing specimens five feet long and under.

2. A frame of two plate girders, together with a pair of large cast-iron skewbacks, previously in the laboratory, a set of steel rods, and other suitable apparatus, so far complete a machine of four hundred thousand pounds' capacity as to enable us, during the present school year, to make some tests of masonry arches of such sizes and proportions as are used in practice.

3. The machine for testing wire has been partly rebuilt, and very much improved.

In No. V. of the "Results of Tests made in the Engineering Laboratories," contained in the double number of the "Technology Quarterly" for June–September, 1896, are published the results of tests made in the course of the regular work of the laboratory, on the following subjects (the greater part having been made during the last school year): —

1. Tests of two series of bolted joints.

2. Tests of wrought-iron pipe of different sizes, used as columns; an investigation suggested by Mr. Hiram F. Mills of the Corporation, which we are still continuing.

3. Tests of spruce, and of Norway pine beams.

4. An extensive series of tests of the compressive strength of timber at right angles to the grain.

5. Torsional tests of shafting, mostly two inches in diameter.

6. Tests of the tensile strength of specimens of steel, and of iron wire, of manilla, of cotton, of hemp, and of sisal rope, and some tests of the strength of certain alloys.

7. Tests of the tensile and of the compressive strength of cement.

8. Torsional tests of wire, carried on in connection with tensile tests of the same wire.

Another investigation in which we are engaged in this laboratory, but of which no results have yet been published, is the strength, and behavior under load, of trusses built of 6-inch by 8-inch timber, with a variety of the framing joints commonly used in practice.

"Notes on Graphical Statics," by Professor Sondericker, has been printed for the use of the students.

A new and revised edition of the text-book on applied mechanics, by Professor Lanza, has been published.

Course III., Mining Engineering and Metallurgy. — The instructing staff of this department remains the same as last year. The largely increasing number of students rendered the addition of an Assistant highly desirable; but the Executive Committee found it possible to supply this want during a portion of the year only. A larger number of students are availing themselves of the advantages of the department than ever before. The numbers now reach a total of forty-one, distributed as follows: twenty-one in the second year, twelve in the third year, eight in the fourth year.

During the past summer Professor Hofman made an extended tour, including Omaha, Kansas City, the Black Hills of Dakota, Denver, Pueblo, and Leadville, with a view to obtaining the latest data upon the metallurgy of silver and lead. The results of his investigations will be embodied in a new edition of his "Metallurgy of Lead," a book which has already

been everywhere accepted as authority. Professor Lodge took the opportunity of the meeting of the American Institute of Mining Engineers, held in Colorado last September, to visit Denver, Pueblo, Leadville, Aspen, Cripple Creek, and other places in the state, to bring his knowledge up to date in matters of sampling, assaying, milling, and smelting of gold, silver, copper, and lead ores. Professor Richards is now embodying the notes obtained in his extended trip through the principal mining regions during the summer of 1895, and also the results of his experiments and investigations made in the Mining Laboratory, in a book upon Ore Dressing, which he hopes to send to press some time next summer. He has spared no pains or expense in bringing the science and theory abreast of modern practice.

A circular has been prepared for the Mining Department, giving the course of instruction; suggestions to students taking the course; the details of the laboratories of mining engineering and metallurgy, together with a statement of the general plan and management. The pamphlet includes a list of theses illustrative of subjects investigated by students during the last term of their course, and finally gives a list of graduates and former students who have been directly or indirectly benefited by the department in their present occupations. This list gives a good idea of the influence this department is exercising upon the mining and metallurgical interests of the United States. Although there has been so much depression in business the past year, all the members of the graduating class have found occupation in the line of their profession.

A new course of lectures in general metallurgy and non-ferrous metallurgy has just been established for students in Chemistry and Chemical Engineering. Formerly the students in these courses attended a portion of the lectures given in the Mining Course. The lectures on electro-metallurgy for students in Electrical Engineering given last year as an experiment, have been adopted as a regular part of that course. The library of the department has grown

to the limit of the present book-shelves; but there is still room for more book-cases. Our collections of ores and products completely fill the present cases. The department will be unable to add to them until additional space shall be provided. Professor Richards has written "The Cycle of the Plunger Jig," a study of the theory of jigging ores for the separation of the waste minerals, also a second paper on "Sorting before Sizing," which discusses the whole theory of separation of the fine slimes. Professors Richards and Hofman have each contributed articles to "The Mining Industry," the former on "Progress in Ore Dressing in 1895;" the latter, on "Recent Improvements in the Treatment of Argentiferous Lead Ores." Professor Hofman has contributed two papers to the American Institute of Mining Engineers: "Further Experiments for Determining the Fusibility of Fire Clays," and "The Equipment of Mining and Metallurgical Laboratories." Professor Lodge has contributed two papers to the American Institute of Mining Engineers: "Treatment of a Roasted Gold Ore by Means of Bromine," and "The Cyanide Process as Applied to the Concentrates from a Nova Scotia Gold Ore."

The following periodicals have been added to the files of the Mining Department: The American Manufacturer; Annales des Mines de Belgique; Cassier's Magazine; Compressed Air; Digest of Physical Tests; Engineering Magazine; Jernkontorets Annaler; Journal of the Canadian Mining Institute; Mining Journal of the Northwestern Mining Association; The Foundry; Transactions of the Institution of Mining and Metallurgy, London.

Course IV., Architecture. — Not much requires to be said respecting the Architectural Department, which continues its steady gain, both in the number of pupils and in the character of the work done, from year to year. The collections of the department have been enlarged by a considerable number of superb architectural casts, although these very important accessories of architectural designing and drawing rooms cannot be placed to the best advantage in the existing build-

ing. Some noble architectural photographs, the gift of Mrs. Henry Draper, have been hung upon the walls. The library has been further increased by purchase, and still more largely by gifts. The library is now one of singular richness, and leaves almost nothing to be desired; but the space allotted to it is so narrow that the large illustrated volumes, photographs, etc., cannot be taken down and used upon the tables with anything like the freedom which is desirable.

An exceedingly important addition has been made to our working plant through the purchase, by Professor Homer, in Paris and London, the last summer, of twenty-six hundred lantern slides, containing views of buildings and cities in western Europe, Russia, and the East. These modern views will admirably supplement the present collection, and will materially assist the illustration of lectures. The views of Spanish, Russian, Indian, and Chinese architecture are particularly valuable, including a large amount of material at present available in no other form. The first instalment has already been received from London, and the remainder is expected at an early date. The new electric lantern of the Architectural Department makes the use of the slides much more convenient and effective. The interest taken by the students in the lectures has manifestly increased with the enlarged use of this mode of illustration. Two prizes, each the income of a fund of $5,000, which were established by the will of Mr. Arthur Rotch, for so long a time chairman of the Visiting Committee on the Architectural Department, became available for the year closing in June last. The prize for the student graduating with the greatest distinction from the regular course in Architecture was awarded to Miss Esther Stone, of Providence, R. I. The prize for the special student completing his course with the highest standing, was awarded to Mr. R. W. Porter, of Springfield, Vt., who is this year continuing advanced studies at the Institute. The Boston Society of Architects have also generously continued their two prizes, each of the value of $50 in books. These were awarded to Messrs. H. W. Chamberlain, of Hudson, Ohio,

and R. C. Henry, of Watertown, Mass. This year, again, in the competitions of the Beaux Arts Society of Architects of New York, the students of the Institute bore off the gold medal and the highest honors in each competition.

Courses V. and X., Chemistry and Chemical Engineering. — Professor Crafts, in a very public-spirited way, consented to continue, during the year on which I am reporting, that supervision and general direction from which the Chemical Department profited so much the previous year. The cares thus assumed by Professor Crafts were wholly in addition to his own proper work of instruction and research. We cannot be too grateful for this invaluable assistance, in our hour of need. Some changes have been made in order to secure more desk room, the fourth floor of the Walker Building is now occupied exclusively by the chemical laboratories, and the places are completely filled. Three hundred and seventy-one students take exercises in general chemistry; one hundred and thirteen students are in the analytical laboratory, and twenty-nine in the organic laboratory. The enlargements were made specially to meet the needs of an increased number of fourth-year students in Chemistry; and they have proved just sufficient for the purpose. It is thought they will also meet all the requirements that can be foreseen for the next two or three years.

The most important change has been the substitution of eight students' desks, and of two small private laboratory rooms for the Chemical Library. The library, which is one of the best in the world, was developed under the energetic direction of Professor Nichols, and each year adds to it every important work on chemistry and allied subjects. It has been of the greatest value to our own students; while the books on chemistry proper, and the rich collections of technical literature, are often consulted by workers outside of the Institute. For our own students the former situation of the library room, adjoining all the large laboratories, made it particularly convenient of access; and it was only after much hesitation transferred from the fourth to the third floor of the Walker

Building. We are pleased, however, to find that the change of place has diminished very little its usefulness to the students, while there is a distinct gain in larger accommodations and in a better ventilated space set apart for tables. In the portion of Room 39 which has been taken for the library the old cases with new additions will hold ten thousand volumes; and, when the time comes for further expansion, one-half more room can be added to the library by removing a temporary partition in Room 39, so that it may be considered that the Chemical Library has found its definitive home. Permanence of arrangement was also held in view in making the necessary additions to the organic chemical laboratory; and it is probable that the fourth floor of the Walker Building is now used to the best advantage; and that, if a new chemical laboratory is constructed, the present conveniences of plumbing, gas, and ventilation will continue to serve, with little change, for the analytical and organic chemical laboratories. At the time the Walker Building was constructed, it was an innovation to place laboratories in the highest story; but experience has shown that the best light and ventilation are thus obtained at the least cost, and that laboratories so placed do not interfere with other uses of a building.

The course of chemical instruction continues to aim at a completely systematized series of studies, while great freedom of development of each branch has found place in the system, stimulated or initiated by the professors or instructors in charge. Reports on these subjects in detail are given as follows: —

ANALYTICAL CHEMISTRY. — The number of students in the analytical laboratory at the present time is one hundred and eleven, distributed among the courses as follows: graduate students, two; fourth year, Mining Engineering, seven; Chemistry, one; General Studies, one; third year, Mining Engineering, fifteen; Chemistry, twenty-eight; Biology, two; Sanitary Engineering, two; second year, Civil Engineering, one; Chemistry, thirty; Biology, six; Physics, two; Chemical Engineering, fourteen. The appointment of Mr. Good-

hue, as Assistant in Analytical Chemistry enables Mr. Rolfe to devote his entire time to sugar analysis, and to sanitary chemistry during the second term, and at the same time provides for the entire services of an Assistant in the analytical laboratory, — a much desired gain. The laboratory course of molecular weight determinations is now conducted in a small laboratory partitioned off from the chemical library in Room 39. A larger room is much to be desired, to accommodate more apparatus, thereby enabling more students to work simultaneously. The equipment of the laboratories and offices with electric lights has added much to their efficiency during the dark afternoons of the fall and early winter.

The instruction in analytical chemistry is continued along the same general lines which have been successfully followed for the last few years, with such minor changes as are necessary to keep abreast of the recent progress in this branch of the science. Much stress is laid upon the class-room instruction. One-half of this is devoted to a study of the current literature in German and French. The student is made familiar in this way with the vocabulary which he must command for the investigation of the records of earlier work written in these languages; and at the same time learns the most recent achievements in analytical chemistry. The results seem to show that such reading can best be done under the direction of an instructor to whom the scientific bearing of the subject-matter is familiar. Before the close of the course, the student is enabled to prepare properly a report upon the literature relating to a specific subject distributed through the various journals, in English, French, and German. The instruction in quantitative analysis of the second year will be facilitated by the use of a manual on the subject, prepared by Professor Talbot, with direct reference to the needs of our students.

ORGANIC CHEMISTRY. — For the first time a considerable number of students (six in all), taking the courses in Physics, Biology, or Chemical Engineering, have selected organic laboratory work as an option, or are taking it as an extra

subject. The professional value to chemical engineers of some practical experience with the principles and methods of organic chemistry is very great; and it is unfortunate that lack of time and accommodations have thus far prevented its introduction as a required subject into the Chemical Engineering course. No radical change has been made in the scheme of instruction. The special course of laboratory experiments on the detection and separation of the various classes of organic compounds, inaugurated last year and mentioned in the previous Annual Report, has been considerably extended and improved, by the publication of a text-book to accompany it. So far as is known, a course of this kind is not as yet presented by any other institution. The success which has attended its introduction here is, therefore, worthy of special notice.

SANITARY CHEMISTRY. — It is more and more clearly recognized that a knowledge of the applications of chemistry is fundamental for the solution of problems relating to private and municipal sanitation. The work, therefore, in sanitary chemistry gains in interest and in educational value year by year, and is demanding more time in the curriculum and more space in the laboratories than the present circumstances allow.

The careful and studied selection of the subjects to be considered, and the manner of treating them, enables the students to gain much more than the simple practice necessary to fit them to carry out analyses of water, air, butter, milk, cereals, etc. They acquire a comprehension of the wider and deeper significance of the work undertaken. Original investigation, limited in amount, to be sure, but illustrative and inspiring, is always encouraged; and this, together with a knowledge of many of the practical problems which are constantly brought to the laboratory from all parts of the country, helps to open out to the students the field of scientific and consulting chemistry. The chemists of the sanitary laboratory are engaged, as far as time will permit, on investigations, and standard methods are being continually

developed. On account of limited space very little new apparatus has been placed in commission. A Victoria centrifugal machine has, however, been added to the equipment. The completion of the laboratories at the State House will leave for the exclusive use of our students the best equipped laboratory for water analysis in the country. Exceptional advantages can then be offered to advanced students.

INDUSTRIAL CHEMISTRY. — With the co-operation of the Steam Users' Association, the subject of the corrosion of boilers by soft waters is to be investigated the present winter.

The course in sugar analysis under Mr. Rolfe, which was provided with a separate room last year, has gone on in a satisfactory manner, and two interesting researches in this field are mentioned among the publications of the year.

The instruction in Gas and Oil Analysis has been given by Dr. Gill, upon much the same lines as last year; but, in consequence of the increased size of the classes, a special assistant — Mr. W. L. Root of last year's class — has been appointed. Our experience since the opening of the year has fully justified this step. In Oil Analysis the collection of specimens has been enriched by the gifts of samples of oil from various manufacturers, who have shown a cordial spirit of co-operation with the department. In Gas Analysis, the notes upon the laboratory and of the lectures have been published under the title " Gas and Fuel Analyses for Engineers," which is believed to be the first work of its kind in the English language. The department is much in need of a larger room. Nor is this need restricted to this department alone; the students of Chemical Engineering have for the past two years had no room — as many other courses have, and as they formerly had — which is particularly their own, in which they can study while at the Institute. Furthermore, as this year's class is larger, the want is felt more pressingly than usual of some special laboratory where their theses can be conducted.

Among the features especially characterizing this depart-

ment is the employment of lecturers from the outside to present subjects with which professional practice has made them familiar. The following are the lecturers in Industrial Chemistry, who are not connected with the Institute: F. G. Stantial, S.B., on Sulphuric Acid; H. Carmichael, Ph.D., on Electrolysis of Brine; Chas. D. Jenkins, S.B., on Illuminating Gas, and on Pottery and Tiles; James W. Loveland, S.B., on Soap; Louis J. Schiller, Ph.D., on Sugar and Sugar Refining; Arthur D. Little, on Wood Pulp and Paper. Dr. Thorp has continued his regular course of lectures in Industrial Chemistry. Several excursions to works and factories in the neighborhood of Boston have been made during the year. The thanks of the Institute are due to the managers of these works for their courtesy and hospitality to our students. The number of lectures has been increased this year by twenty, which permits a more complete discussion of many subjects than was possible last year. The number of students in the class is thirty-seven. In Textile Coloring, Mr. Smith has made a change whereby two hours per week are devoted to lectures instead of one hour as formerly. This extra hour has been taken from the time given to laboratory work. Inasmuch as the greater number of dyeing operations require between three and four hours, and none more than four, this was done without curtailing the laboratory work, by utilizing an hour that had often been superfluous.

In conclusion it must be noted that the increase in the number of chemical students has made the old accommodations for lectures and recitations insufficient; there is the greatest difficulty in arranging appropriate hours, and experimental lectures are given an inadequate time for moving apparatus, so that, in this direction almost more than in any other, the need for a new building is felt.

The following publications have been made during the year by members of the Chemical Department:

Theoretical Chemistry.

A. A. Noyes: 1. Die katalytische Wirkung der Wasserstoffionen auf polymolekulare Reaktionen. 2. Bemerkung über das Gesetz der Geschwindigkeit der Reaktion zwischen Eisenchlorid und Zinnchlorür. 3. Instruction in Theoretical Chemistry.

A. A. Noyes and H. M. Goodwin: On the Viscosity of Mercury Vapor.

A. A. Noyes and C. W. Hapgood: An Investigation to Determine whether Diphenyliodonium and Thallium Nitrates are Isomorphous.

W. R. Whitney: 1. Untersuchungen über Chromsulfat-Verbindungen. 2. Translation of "The Elements of Electrochemistry," by M. Le Blanc.

Organic Chemistry.

H. Fay: The Action of Light on Some Organic Acids in the Presence of Uranium Salts.

J. F. Norris (with Ira Remsen): The Action of the Halogens on the Methylamines.

A. A. Noyes and S. P. Mulliken: Laboratory Experiments on the Class Reactions of Organic Substances and their Identification.

A. A. Noyes and C. W. Tucker: Formation of Diacetylenyl from Copper Acetylene.

Analytical Chemistry.

G. Defren: The Determination of Reducing Sugars in Terms of Cupric Oxide.

A. H. Gill: Gas Analyses for Engineers.

J. F. Norris and H. Fay: Iodometric Determination of Selenious and Selenic Acids.

G. W. Rolfe and G. Defren: An Analytical Investigation of the Hydrolysis of Starch by Acids.

H. P. Talbot and A. G. Woodman: Analysis of an Old Rail from an Unused Coal Mine.

H. P. Talbot: A Brief Course of Quantitative Analysis.

Sanitary Chemistry.

G. Defren: The Determination of Nitrites in the Air.

E. H. Richards and G. W. Rolfe: The Reduction of Nitrates by Bacteria and Consequent Loss of Nitrogen.

E. H. Richards: 1. Water and Air as Food. 2. The Teaching of Sanitary Chemistry. 3. Some Points in the Use of Depth of Color as a Measure of Chemical Contents. 4. Municipal Responsibility for Healthy School Houses. 5. Hardness of Water and the Methods by which it is determined. 6. Hospital Diet. 7. The Chemistry of Cooking and Cleaning. (New Edition.)

Inorganic Chemistry.

H. P. Talbot: On the Volatility of Ferric Chloride.

F. H. Thorp: 1. Manual of Inorganic Chemical Preparations. 2. A Review of Some Improvements in Chemical Industry.

Courses VI. and VIII., Electrical Engineering and Physics. — Very substantial additions have been made to the material for instruction in Physics and Electrical Engineering. Especially is this true regarding instruments of precision. Besides duplicating much apparatus of this kind already possessed, various new instruments have been added. Among these should be mentioned the gift by Mrs. Draper of a mechanical air-pump, a mercurial air-pump, and two dynamo-machines, which were used by the late Dr. Henry Draper in his researches. There has also been presented by the General Electric Company an Edison potential regulator, an instrument of much historical interest. We have made a great addition to our lantern-slides, about five hundred having been added. These have all been made in our own laboratory by Mr. Derr. A valuable addition to the workshop of the department has been made in the shape of a Fitchburg engine lathe with fourteen-inch swing. As an illustration of the exceptional manner in which the needs of our classes of students are provided for, it may be mentioned that we have fifty ampere-meters and volt-meters of the first grade of excellence

for accurate work, in addition to many of a less degree of precision.

Especially important is the large increase of our dynamo-electric machinery. During the past year there have been added a 30-arc light (2,000 candle-power) Brush machine; a 30-horse-power 4-pole direct-current Westinghouse machine; and a 10-horse-power Westinghouse direct-current machine, arranged so as to give also quarter-phase alternating currents when desired. This last mentioned machine can be used either as a direct or alternating-current motor, or as a rotary transformer. There have also been added two 20-horse-power transformers for electric-lighting currents, a transformer, giving a pressure of 40,000 volts, for the study of the insulating power of different materials, and a low-voltage transformer for the production of very heavy currents up to 3,000 amperes, besides several dynamo machines of smaller capacity. Still more important is the new experimental plant of combined dynamo and steam engine, the need of which was urged in the President's Report of last year, and its purchase authorized by the Executive Committee in the spring of 1896. This is now in process of installation. It consists of two similar 4-pole moderate-speed direct-current generators of 35-horse-power each, made by the General Electric Company. These are driven by a belt connection from a Westinghouse compound engine of 105-horse-power at 125 pounds steam pressure. This engine will be furnished with condensers and weighing tanks, for weighing the exhaust steam, and with an indicator rig. The plant is especially designed for purposes of accurate testing and measurement. A special switch-board will allow of all desirable electrical combinations of the dynamo machines.

Next to thorough and accurate teaching, perhaps nothing is more important in a professional course than the manner in which it is laid out, — the sequence of studies and the relative time assigned to each branch. The increased entrance requirements in Mathematics, the effect of which is now being felt in the upper years, are bringing about a marked improve-

ment in all the courses of instruction. In the courses in Physics and Electrical Engineering, in which there is desired an early introduction of more advanced mathematical methods than have hitherto been available, the gain is particularly helpful. Its full advantage will not be secured until next year, when the fourth-year class will for the first time proceed under the revised schedule, but improvement is already manifest in the work of the second and third years.

The principal change which proved feasible in the past year was the introduction of a new course of fifteen lectures given by Professor Cross in the first term of the third year, devoted to the principles of dynamo-electric machinery, and its applications to electric lighting, the electrical generation, transmission and utilization of power, and similar topics. This is to serve as an introduction to the more specific and technical treatment of these subjects in the last year of the course. After the present year, these lectures will also be attended by students of the courses in Civil, Mechanical, Mining, Chemical, and Sanitary Engineering, and in Chemistry. The exercises in memoir work, which for many years past have been held in connection with the fourth year of the Course in Physics, have been somewhat modified in a way decidedly to increase their value. A Physical Colloquium is now held once each fortnight throughout the year, under the direction of Dr. Goodwin; and much more practice than formerly is given in making abstracts of current literature in foreign languages. The course in Heat Measurements was given last year by Mr. Norton, that in Precision of Measurements by Professor Clifford, and that in Electrical Measuring Instruments by Mr. Laws, as the condition of Professor Holman's health was such as to forbid his taking charge of them. Mr. Laws also took the immediate charge of the Laboratory of Electrical Measurements. Several new courses of lectures to be opened in the department this year should be referred to here. The first of these, by Professor Clifford, will be devoted to an extended discussion of the Electromagnetic Theory of Light, intended especially

for the benefit of graduate students and advanced students of the Course in Physics. The second, by Mr. Derr, will be devoted to the subject of the theory and practice of Photography, and will be open to members of the three upper classes. It is hoped that in time this course may be extended to include a consideration of the arts of photo-mechanical printing and other like processes, which, as far as I am aware, are not at present discussed in any of our technical schools.

A course of combined lectures and laboratory exercises in Dynamo-Electric Measurements has been given for the first time by Professor Puffer to third-year students in Mechanical and Mining Engineering. This runs parallel with the lectures on the Industrial Applications of Electricity, already mentioned, which are also taken by these students. Instruction is given in the simpler methods of testing dynamo-electric machinery. The course of lectures in Electrical Measuring Instruments, given by Mr. Laws to students in Electrical Engineering and Physics, has been extended into the fourth year, in order to allow of a more detailed consideration of the measurement of alternating currents. During the past year a number of valuable papers, mostly based upon work done in the Physical Laboratory, have been published from the department in the "Proceedings of the American Academy," the "Technology Quarterly," and elsewhere. In the spring, extended experiments were carried on in the department in connection with the newly discovered "X-Rays" of Röntgen, and various important observations were made. Among these may be especially mentioned the independent discovery by Dr. Goodwin of the fact that these rays act to dissipate both negative and positive charges. The fact had not before been known in this country, and its original publication abroad was only a few days earlier. Messrs. Norton and Lawrence gave much assistance to Dr. F. H. Williams, of the Corporation, in developing an apparatus that should be suitable for ready use in surgery and medicine.

In my last Report I emphasized the difficulties sustained by this department from the entirely inadequate amount of room at its disposal. The great pressure which this restriction places upon the work of the fourth year in Electrical Engineering and Physics cannot be other than detrimental to its success. That it is not far more so is due only to most earnest effort on the part of teachers and pupils alike. In some of our higher work in Physics we now find ourselves in a position where it is difficult even to continue the work which we are doing. I refer to the courses in Heat Measurements and Physical Chemistry. It is over ten years since Professor Cross proposed the creation of a laboratory for the investigation of problems in heat, analogous to the laboratory of electrical measurements. For various reasons the institution of such a course in heat measurements and the establishment of such a laboratory were much delayed. This was finally done, however, the work being undertaken by Professor Holman; but no additional room could be obtained for it, so that a narrow strip had to be taken from one of the rooms constituting the laboratory of electrical engineering. This room, 16 × 29 ft., is all that we have now for this important work. Even this is not available except in the first term, as in the second term it has to be occupied in part for thesis work in electrical engineering or physics. The number of students taking Heat Measurements will be increased next year by the whole fourth-year class in Mining Engineering, which is likely to more than double the total number of those pursuing this subject. It is impossible to see how the needs of these students are to be met.

Even more serious at the present time is the fact that the laboratory of Chemical Physics, which was opened two years ago (the room for this also being taken from the laboratory of electrical engineering), is now crowded beyond its utmost capacity. It has been necessary to carry on some of the thesis work in Physics in this room. Up to the present time this has been possible, and not incompatible with the work of instruction in chemical physics. But the simultaneous in-

crease in the number of students in the Course in Physics, and the introduction of chemico-physical work into the Course in Chemistry, which latter course is rapidly increasing in numbers, is putting us in a most serious position. If nothing beyond the present room is to be available, the only apparent remedy is to cease to give a portion of the instruction which has been undertaken. This at least is feasible; and objectionable as such a procedure would be, it seems preferable to carrying on such work in an inefficient manner, which would be demoralizing alike to students and teachers. The work in heat measurements and chemical physics is of such present and growing importance as to demand for its full success a space comparable with that allotted to the laboratory of electrical measurements. There is, furthermore, as last year, a painful lack of general lecture and class-room accommodations. Were the pressure for room in the above mentioned directions less severe, I should call attention to the crowded state of the study-room and library (No. 14), and the need of more room for the safe-keeping of apparatus. The uniformly good order and quiet maintained by the students has, however, prevented detriment from the former of these causes.

Course VII., Biology. — For several years the Institute largely through the co-operation of the Biological Department with the Departments of Chemistry and Civil Engineering, has occupied the leading position in sanitary science among schools of engineering in the United States. The importance of this position is obvious when it is realized that some of the greatest engineering undertakings of the present time — such, for example, as the gigantic scheme of a metropolitan water supply for Boston and the more than two score cities within the Boston Basin — owe their origin chiefly to the enlightened demands of modern sanitary science.

The present year marks another notable development of the work of the Biological Department on the technological side, by the establishment of a regular course of lectures and laboratory work in Industrial Biology. As it is believed that

such a course is entirely new in the United States, it requires more than passing notice.

The rapid progress of bacteriology has made necessary an entirely novel point of view in the arts and industries dependent on the activity or the exclusion of micro-organisms. Some industries, such as brewing, the leavening of bread, the making of butter and cheese, and the manufacture of vinegar, depend upon the successful cultivation and co-operation of micro-organisms (yeasts, molds, and bacteria), — facts which are often unknown even to those engaged in these arts or industries. Within two or three years the cultivation of butter-making bacteria has become of practical importance, and many creameries now use pure cultures of bacteria for the "ripening" of their cream as a preliminary to churning, instead of trusting to chance, as does the housewife, that the right micro-organisms shall fall in, and as was the universal custom, even in creameries, until very recently. In this new departure the Biological Department of the Institute has taken a prominent part, one of its graduates and former instructors being now engaged commercially in the propagation of the necessary butter bacteria for this new industry.

One of the latest developments along a similar line is the investigation of the bacteria of tanneries. It has long been known that hides and skins are fermented with great advantage after the hair has been removed from them, and before they are put into the tan-liquor. One of the instructors in Biology has for the past few months been carefully studying the micro-organisms concerned in these fermentations, and with most interesting and valuable practical results for the leather making industry.

Other industries, such as the preparation of canned foods, cold storage, drying, salting, smoking, and pickling, depend for their success not on the activity, but on the exclusion, inhibition, or destruction of micro-organisms. In this direction also much is being done. The causes of the spoiling of canned clams and lobsters are under investigation, with every indication of success and ultimate escape from the heavy

losses now entailed upon the manufacturer by imperfect processes. Some of these processes are briefly treated in works on industrial chemistry, but the time has now come when they must be more carefully studied from the biological standpoint, and to this end a course of three hours a week, for a half year, was established, and is now under way. It is open to graduate, senior and special students in Biology and Chemistry, and runs parallel with the course in general Bacteriology, of which it may be considered an outgrowth. Developments like these, in applied biology, make it not less but more necessary to maintain the purely scientific work of the department which underlies and supports them. The work in Physiology and Hygiene continues to be ably conducted by Assistant Professor Hough; that in Zoölogy and related subjects is in charge of Dr. Weysse; the instructor in Botany is Mr. Prescott, who also assists Professor Sedgwick in his courses in General Biology, Bacteriology, Industrial Biology, Microscopy, etc. Through the generosity of Augustus Hemenway, Esq., the equipment has been materially strengthened by the addition of several costly high-power microscopes, which were greatly needed on the bacteriological side. To Mrs. William B. Rogers the department of Biology is once more indebted for the use of tables in the Marine Biological Laboratory, at Wood's Hole, which were occupied with great advantage, during the summer, by Mr. Prescott and Mr. Stiles, a fourth-year student.

One of the most gratifying features of the year has been the resort to this department of several graduate, or advanced special students, who desire to make particular investigations chiefly in sanitary or industrial Biology. Every effort has been made to provide suitable accommodations for them; but the painfully congested state of the single room which still is made to serve for the steadily growing needs of the department has rendered it impossible for us to do for them what we should have been glad to do. Further adaptation has become impossible. Professor Sedgwick has only been able to meet the demands of the present year, and that

inadequately, by taking two workers into his own small office.

Course IX., General Studies. — I have spoken of the large amount of material, maps, charts, and diagrams, which has been prepared for illustrating the first and second-year courses in history which are taken by all regular students. The same aids are introduced into the course in the history of the Renaissance and the Reformation taken by third and fourth-year students of the Courses in Architecture, Biology, and General Studies.

Furthermore, for the history of the Renaissance several hundred of the best isochromatic photographs, many of them in carbon or platinum, were purchased for the department by Mr. Sumner while in Europe last summer. In this selection, the historical interest of the subject, as notably in the case of portraits, as well as the importance of the work in the development of art, was emphasized. This collection illustrates the development of Romanesque, Gothic, and Roman sculpture, both in Italy and the North of Europe. For purposes of comparison, a few photographs from the early German and Flemish masters are included. I very highly approve of Professor Currier's suggestion that, as soon as it can be done, arrangements be made for a permanent exhibition of these photographs in such a way that some considerable part of them may be displayed at any given time, other sections of the collection being introduced into the frames at stated times, so that all may be brought under the observation of the student in the most effective way.

It is a proper subject for congratulation that Professor Dewey has been appointed by the Governor a member of the State Commission, created under a recent law, to investigate the charitable and reformatory interests and institutions of the State. It will be remembered that, three years ago, Professor Dewey was called to serve the State as chairman of the commission appointed to investigate the subject of the unemployed. I consider it sound policy for an institution of the higher learning liberally to encourage its professors to

connect themselves with the public service, and with the active interests of the community in every way, and to every degree which may be compatible with the full and proper performance of their duties as teachers. Altogether in addition to the consideration of the service that may be thereby performed for the state and its citizens, I believe that the teachers bring back to their classes from such work and service much which is of great value to the student. It is in order also to make reference to Dr. Ripley's recent publications on Anthropology, and his Lowell lectures of the present season, on the same subject, which will be collected and published in book-form next year.

Another graduate in the course in General Studies at the Institute of Technology, Mr. William Herbert King, has been appointed to a fellowship at Columbia University. Mr. King is the third graduate from this course who has received that honor from Columbia University. A new circular has been prepared for the General Course, the issue of 1891 having become exhausted, and the changes of the intervening years being numerous and important.

Course XII., Geology. — The instruction in Geology and Mineralogy is largely auxiliary to courses in certain other departments. The classes in the general subjects are large, and the students show a commendable appreciation of the work.

The combination of studies in the schedule of the course has met with the approbation of working geologists and men of science. The demand for our graduates is so good that they have been more successful in obtaining satisfactory positions than is usual in professional life.

Three students took their degree in the department of Geology last June, two of whom had then accepted appointments for the present year, while the third was only prevented by temporary disability from engaging in work.

Much of the work of the students in the department last year is worthy of notice. Mr. A. W. Grabau's graduation thesis was "Characteristics and Succession of the Fossil

Faunas of the Middle Devonian (Hamilton) at Eighteen Mile Creek, New York;" and he has continued the same line of investigation in an extended and critical study of the fossil faunas of the Hamilton Group in Western New York, which is ready for publication in the official Reports of the Survey of that State.

The work represented by the graduating thesis of Mr. Myron L. Fuller has been amplified with the assistance of Professor Crosby, and will be published as a joint paper in the "Technology Quarterly" and the "American Geologist." A study which Mr. Fuller made as a student has been published in the Proceedings of the Boston Society of Natural History under the title of "A New Occurrence of Carboniferous Fossils in the Narragansett Basin."

In the preparation of her thesis upon "The Geological History of Lake Cochituate" Miss Elizabeth F. Fisher made a study worthy of record, and it is to be hoped that her observations may be extended and the results published. Miss Fisher is now Instructor in Geology in Wellesley College.

The increased interest in nature studies has enforced requests from the teachers of science in the public schools for opportunities for laboratory practice in mineralogical and geological work. It is believed that a cordial response on the part of this department will add to the reputation of the Institute and aid the Commonwealth in its educational work. The Faculty has voted to introduce a course in Geological Laboratory work for special students.

The collections in Economic Geology, Mineralogy, and Paleontology have been improved in quality and extent. Each year the material is being better selected, arranged, and labelled, — a work which must be performed in the intervals of more pressing duties, and which requires a great deal of time and patience. The constant wear of maps, diagrams, and apparatus, and the advance of science have necessitated the replacing of some of the old by new and improved appliances. The geological library is steadily receiving accessions.

Course XIII., Naval Architecture. — The work of this department has gone steadily on during the year; but there have been no changes of sufficient importance to require to be indicated here. The need of a separate drawing-room for the students in Naval Architecture has been pointed out elsewhere in this Report. By permission of the Secretary of the Navy, and through the courtesy of Chief Naval Constructor Philip Hichborn and Commodore Miller, commandant of the Boston Navy Yard, the department has been able to give instruction in mould-loft work, for two years past, just after the close of the school year. The first year the instruction was given by an experienced mould-loft man, under the direction of Mr. Swan. Last year the instruction was given by Mr. Swan, assisted by Mr. Clark. The work lasted about ten days, during which the students learned to perform all the ordinary operations of the mould-loft, and laid down nearly all the lines for an important ship. It is found that students who have learned to draw ship-lines on paper, and who are familiar with the principles of descriptive geometry, learn mould-loft work rapidly, and that they take a great interest in their work. I do not know that this particular work is given in any other technical school of our grade.

Mr. James Swan, who has since 1893 been Professor Peabody's principal assistant, has been given a leave of absence for a year, to enable him to pursue advanced studies in shipbuilding at the University of Glasgow. His work this year is being carried on exceedingly well by Mr. Clark. I entertain no doubt that Mr. Swan will bring back from his foreign study much which will be of use in the further development of our course in Naval Architecture. Professor Peabody reports that all his last year's graduates are engaged upon professional work.

This concludes the history of the Institute since I last had the honor to make my report to the Corporation. Much might be added; but I have, I trust, given details enough to show the real condition of the school, and its most important

needs. I cannot close without a word to express the grief and sense of loss which the death of Mr. Bouvé has brought to the Faculty of the Institute. Notwithstanding his impaired strength and the infirmities which for years have made life a burden to him, he did not even diminish the attention which he had been wont, from the foundation of the school, to give to the interests and needs of the departments of Geology and Mining and Metallurgy. No school ever had a better adviser. When the history of this school shall be fully written, the name of Thomas T. Bouvé will be found high up on the roll of its founders and early directors.

TREASURER'S REPORT.

STATEMENT OF THE TREASURER.

THE treasurer submits the annual statement of the financial affairs of the Institute for the year ending September 30th, 1896.

The results this year are far more satisfactory than last, and show a balance of twenty-three hundred and fifty dollars and twenty-seven cents on the credit side of the account, instead of a deficit of fifteen thousand nine hundred and thirty-five dollars and twenty-nine cents, as was the case the preceding year. This favorable change is due for the most part to the generous grant of twenty-five thousand dollars made by the Commonwealth. The unfavorable side of the matter is that whereas the grant was twenty-five thousand, the balance is only a little over two thousand; and further, that the grant is only to continue for five years more.

Both repairs and general expenses have increased, and this is in part due to the overcrowded condition of the buildings. The effort to accommodate more students leads to many changes, which are in no sense permanent improvements. The need for a new building is becoming imperative, but the money for such an extension is lacking.

Generous gifts have been received during the past year.

Under the will of Ann White Vose, $52,827.36 have been added to the scholarship funds; and through the generosity of Charles H. Dalton, Esq., the Dalton Graduate Chemical Fund of $5,000 has been established.

The William Hall Kerr Library Fund of $2,000 was given by Mrs. Kerr in memory of her husband, and $500 were received from Augustus Hemenway, Esq., for the Biological Department. Mrs. William B. Rogers gave $200 for the purchase of periodicals, and from other friends came $400 for the Chemical and $250 for the Mathematical Departments.

There have also come to the Institute the following legacies and devise, which are not restricted to any special use, and are available, either as to income, or as to both principal and income, for the general purposes of the Institute: —

Henry E. Hutchins,	legacy	$2,000 00
Moses Kimball	"	5,000 00
Benjamin P. Cheney	"	10,000 00
Samuel E. Sawyer	"	4,414 66
Catherine P. Perkins	" (additional)	6,568 40
Susan G. Coolidge, devise		14,500 00

As a result of all the above gifts, there has been a net increase in the property of the Institute to the amount of $107,178.10, of which more than half is for scholarships. The value of such scholarship funds is very great. They enable many excellent students to obtain the benefits of an education which they must otherwise forego. The average standing and scholarship of those receiving this aid is very high, and there can be no doubt that they will turn to good account in after-life the training which these generous gifts place within their reach. To these most deserving students the benefit is a great and a lifelong one.

As a purely financial matter, however, these scholarship endowments do not enrich the Institute at all or aid it to meet its expenses, as will readily be understood when it is borne in mind that the average student costs the Institute annually in cash payments about two hundred and sixty-seven dollars, while the tuition fee is only two hundred dollars. In fact, the student really receives from the Institute much more than two hundred and sixty-seven dollars, since he has also the use of the buildings and scientific apparatus. To meet the excess over the tuition fees the Institute must rely on the general, unrestricted funds, and it is only through these that its work can be continued. It is therefore important that the friends of the Institute should understand, — first, that scholarship gifts are most gratefully received, and do a most important work; but, second, that such gifts make only more necessary the gift of unrestricted funds with which to meet the general expenses of the Institute.

SECURITIES SOLD OR PAID, W. B. ROGERS MEMORIAL FUND.		
$7,000 Omaha & Southwestern R. R. 8s. 1896 . .		7,000.00
SECURITIES SOLD OR PAID. GENERAL FUND.		
$1,000 Union Pacific R. R. 6s. 1898	1,050.00	
27 Shares Essex Co. dividend of capital . . .	270 00	
		1,320.00
PURCHASE OF SECURITIES, W. B. ROGERS MEMORIAL FUND.		
$6,000 New York & New England R. R. 1st 6s. 1905		6,750.00
SECURITIES BOUGHT OR RECEIVED AS LEGACIES. GENERAL ACCOUNT.		
50 Sh. New York, New Haven & Hartford R. R.	8,000.00	
Real Estate, Main Street, Cambridge	16,154.38	
37 Sh. Nat. Mechanics Bank, Baltimore	706.70	
10 Sh. First Nat. Bank of Baltimore	1,293.30	
16 Sh. Boston Real Estate Trust	18,400.00	
$5,000 New York & New England R. R. 1st. 6s. 1905	5,612.50	
		50,166.88

GEORGE WIGGLESWORTH, TREASURER, *in account with*
GENERAL STATEMENT OF RECEIPTS AND DISBURSEMENTS
Dr.

Cash balance Sept. 30, 1895		21,807.33
From Augustus Lowell for Lowell Courses	5,825.00	
" " " " C. Kastner's salary	2,500.00	
" " " " School of Design	500.00	
		8,825.00
RECEIPTS FOR CURRENT EXPENSES.		
Income of funds for salaries	3,942.00	
" " " " scholarships (students' fees)	4,269.12	
" " " " " " " 1895	705.88	
" " " " Joy "	200.00	
" " " " Swett "	400.00	
" " " " Savage "	400.00	
" " " " Library	495.00	
" " " " general purposes	9,187.60	
" " Rogers Memorial Fund	9,570.09	
" " Charlotte B. Richardson Fund,	1,682.04	
Students' fees	216,767.50	
State Scholarships	2,000.00	
State Agricultural Fund	5,592.52	
State Endowment Fund	7,333.34	
Gift of State of Massachusetts	25,000.00	
Laboratory supplies and breakages	8,739.74	
Rents, per Table (page 92)	13,306.58	
Gifts	1,558.07	
Interest	3,670.41	
Boston University	1,150.00	
Sale printed Lecture Notes	3,006.12	
		318,976.01
GIFTS AND BEQUESTS FOR SPECIAL PURPOSES.		
Increase Richard Perkins Fund,	470.93	
" James Savage Fund,	179.31	
" Joy Fund	567.87	
" Letter Box	111.00	
" Susan Upham Fund,	51.35	
" W. B. Rogers Fund, additional	50.00	
Susan E. Dorr Fund	115.09	
Arthur Rotch Prize Fund	225.00	
Arthur Rotch "Special" Prize Fund	225.00	
T. Sterry Hunt Fund, additional	82.74	
Ann White Vose Fund	53,232.36	
Dalton Graduate Chem. Fund	5,090.00	
Wm. Hall Kerr Library Fund	2,000.00	
Biological Instrument Fund	500.00	
Mathematical Department Fund	250.00	
		63,150.65
GIFTS AND BEQUESTS FOR GENERAL PURPOSES.		
Henry E. Hutchins Legacy	2,000.00	
Moses Kimball Legacy	5,000.00	
Benj. P. Cheney Legacy	10,000.00	
Susan G. Coolidge Devise	14,500.00	
Samuel E. Sawyer Legacy	4,414.66	
Catherine P. Perkins Legacy (additional)	6,568.40	
		42,483.06
SECURITIES SOLD OR PAID. GENERAL FUND, page 83		1,320.00
" " " Rogers Fund, page 83		7,000.00
SUNDRIES.		
Income credited to Bond Premium Acc't	533.90	
Income credited to Rogers Bond Premium Acc't	521.41	
Boston Art Students' Asso. on acc't	666.66	
Students notes paid	950.00	
Profit and Loss, per page 85	2,350.27	
		5,022.24
		$468,584.29

MASSACHUSETTS INSTITUTE OF TECHNOLOGY.
FOR THE YEAR ENDING SEPTEMBER 30, 1896.

Cr.

Paid for Lowell Courses	5,825.00	
" " Charles Kastner's salary	2,500.00	
" " Expense Lowell School of Design	500.00	
		8,825.00
EXPENSES.		
Salaries, per Table (page 92)	217,028.58	
" paid from Gifts	500.00	
Fellowships paid from Swett Fund	400.00	
" " " Savage "	400.00	
Repairs, per Table (page 93)	9,403.17	
General Expenses, per Table (page 93)	14,631.46	
Fuel	9,025.20	
Water	1,775.65	
Gas	2,254.81	
Electricity	782.01	
Printing and Advertising	2,360.37	
" Lecture Notes	3,708.93	
" Annual Catalogues and Reports	2,629.89	
Rents paid Boston & Albany R. R. Co.	180.00	
" " Natural History Society	200.00	
Laboratory Supplies and Libraries, per Table (page 92)	37,564.99	
Society of Arts	939.43	
Casts, &c., Rotch Fund	292.60	
Photograph, Gift	216.07	
Interest 4.50 per cent on funds not in stocks and bonds	5,765.63	
Interest paid A. Lowell, Trustee	1,000.00	
" " on Mortgage Notes	5,566.95	
Profit and Loss. Income more than expenses	2,350.27	
		318,976.01
SECURITIES BOUGHT OR RECEIVED AS LEGACIES. GENERAL ACCOUNT, page 83		50,166.88
PURCHASE OF SECURITIES WM. B. ROGERS MEMORIAL FUND, page 83		6,750.00
Income of Joy Fund, deposited		567.87
Projected Building, Trinity Place, plans		169.50
SUNDRIES.		
Notes Receivable	60,000.00	
Students' Deposits	100.00	
Scholarship Funds, 1895, used	705.88	
		60,805.88
Cash balance, Sept. 30, 1896		22,323.15
		$468,584.29

The following account exhibits the property held by the Institute, as per Treasurer's books, Sept. 30, 1896 : —

INVESTMENT OF THE W. B. ROGERS MEMORIAL FUND.

$50,000.00	Saginaw & Western R. R. 6s. . . .	1913	50,000.00	
30,000.00	Burlington & Mo. River R. R. 4s. .	1910	25,787.50	
27,000.00	Kansas City Belt R. R. 6s.	1916	27,000.00	
16,000.00	Kansas City, Clinton & Springfield R. R. 5s.	1925	16,000.00	
6,000.00	New York & New England R. R. 6s.	1905	6,000.00	
5,400.00	Republican Valley R. R. 6s. . . .	1919	5,400.00	
4,000.00	Cin., Ind., St. Louis & Chicago R. R. 6s.	1920	4,000.00	
2,000.00	Ottawa, Oswego & Fox River R. R. 8s.	1900	2,000.00	
2,000.00	Kansas City, Fort Scott & Gulf R. R. 7s.	1908	2,000.00	
3,000.00	Kansas City, Memphis & Birmingham R. R.			
	1,000 General Mortgage 4s. . . .	1934		
	2,000 Income 5s.	1934		
			2,221.40	
1,000.00	Lincoln & Northwestern R. R. 7s. .	1910	1,000.00	
1,000.00	Atchinson & Nebraska R. R. 7s. .	1908	1,000.00	
42,000.00	Chicago, Burlington & Quincy R. R. Conv. 5s.	1903	40,820.00	
35,000.00	Fort Street Union Depot 4½s. . . .	1941	34,825.00	
24,000.00	Rome, Watertown & Ogdensburg R. R. 5s.	1922	24,000.00	
	Advances to Bond Premium account .		8,400.00	
	Bonds			250,453.90

INVESTMENT OF THE JOY SCHOLARSHIP FUND.

	Massachusetts Hospital Life Insurance Co. .	5,000.00	
	Deposits in Savings Banks	4,123.70	
			9,123.70

INVESTMENT SWETT SCHOLARSHIP FUND.

	Massachusetts Hospital Life Insurance Co.	10,000.00

INVESTMENTS, GENERAL ACCOUNT.

$14,000.00	Bur. & Mo. River (Neb.) R. R. 6s. non-exempt	1918	14,000.00	
2,000.00	Bur. & Mo. River (Neb.) R. R. 6s. exempt	1918	2,000,00	
6,000.00	Chicago, Burlington & Quincy R. R. 4s.	1922	5,100.00	
3,000.00	Milwaukee & St. Paul R. R. 7 3-10 .	1898	3,000.00	
4,000.00	Chicago, Burlington & Northern R. R. 5s.	1926	4,000.00	
2,000.00	Kansas City, Fort Scott & Gulf R. R. 7s.	1908	2,000.00	
3,000.00	Hannibal & St. Joseph R. R. 6s. . .	1911	3,000.00	
15,000.00	Chicago, Burlington & Quincy R. R. Conv. 5s.	1903	15,000.00	
6,000.00	West End Street Ry. 5s.	1902	6,000.00	
2,000.00	Brookline Gas Light Co. 5s. . . .	1913	2,000.00	
35,000.00	Fitchburg R. R. 5s.	1903	35,000.00	
65,000.00	Boston & Maine R. R. 4½s.	1944	65,000.00	
26,000.00	Am. Dock & Improvement Co. 5s. .	1921	26,000.00	
3,000.00	Illinois Central R. R. 4s.	1951	3,000.00	
5,000.00	New York & New England R. R. 6s.	1905	5,000.00	
	Advances to Bond Premium account		5,539.84	
	Bonds			195,639 84
	Amount carried up			$465,217.44

Amount brought up					465,217.44
STOCKS.					
SHARES.					
148	Boston & Albany R. R.	par	100	29,933.00	
194	Morris & Essex R. R.	"	50	14,690.00	
40	New York & Harlem R. R.	"	50	5,000.00	
85	Pittsburg, Fort Wayne & C. R. R.	"	100	12,880.00	
50	N. Y., New Haven & Hartford R. R.	"	100	8,000.00	
12	Cocheco Manufacturing Co.	"	500	6,000.00	
56	Hamilton Woollen Co.	"	100	5,390.00	
59	Everett Mills	"	100	5,310.00	
31	Great Falls Manufacturing Co.	"	100	3,472.00	
6	Manchester Mills	"	100	660.00	
2	Dwight Manufacturing Co.	"	500	1,600.00	
1	Merrimack Manufacturing Co.	"	1000	1,015.00	
1	Laconia Co.	"	400	605.00	
2	Pepperell Manufacturing Co.	"	500	2,300.00	
10	Lowell Bleachery	"	100	975.00	
27	Essex Co.	"	50	3,780.00	
158	Pennsylvania Coal Co.	"	50	23,160.50	
15	Consolidated Gas Co., New York	"	100	1,447.50	
7	Lowell Gas Light Co.	"	100	1,610.00	
40	Cambridge Gas Light Co.	"	100	7,000.00	
7	Lawrence Gas Light Co.	"	100	882.00	
55	Old Boston National Bank	"	100	5,510.50	
15	Merchants' National Bank	"	100	2,220.00	
25	New England National Bank	"	100	3,875.00	
25	Atlantic National Bank	"	100	2,875.00	
10	National Union Bank	"	100	1,240.00	
25	National Bank of the Republic	"	100	3,625.00	
40	The Molsons Bank, Montreal	"	50	3,000.00	
37	Nat. Mechanics Bank, Baltimore	"	10	706.70	
10	First Nat. Bank of Baltimore	"	100	1,293.30	
16	Boston Real Estate Trust	"	1000	18,400.00	
					178,455.50
REAL ESTATE.					
Rogers Building				200,000.00	
Walker "				150,000.00	
Land on Garrison Street			50,840.00		
Workshops " "			30,000.00		
				80,840.00	
Land on Trinity Place			76,315.69		
Engineering B'ld'g, Trinity Place			90,000.00		
				166,315.69	
Gymnasium Building				7,967.85	
Architects' "				57,857.10	
Lot No. 2 Trinity Place				137,241.60	
Projected Building, Trinity Place, plans . . .				169.50	
Clarendon St. Land and Building				142,762.94	
House No. 34 Commonwealth Ave.				30,000.00	
Real Estate, Main Street, Cambridge . . .				16,154.38	
					989,309.06
Equipment, Engineering Building				16,555.24	
" Workshops				20,628.56	
					37,183.80
SUNDRIES.					
Notes Receivable				61,500.00	
Boston Art Students' Association				13,000.00	
Students' Notes				2,783.00	
Cash Balance, Sept. 30, 1896				22,323.15	
					99,606.15
					$1,769,771.95

The foregoing Property represents the following Funds and Balances, and is answerable for the same.

The income of the following is used for the general purposes of the Institute:

William Barton Rogers Memorial Fund	250,225.00	
Richard Perkins Fund	50,000.00	
George Bucknam Dorr Fund	49,573.47	
Martha Ann Edwards "	30,000.00	
Nathaniel C. Nash "	10,000.00	
Sidney Bartlett "	10,000.00	
Robert E. Rogers "	7,680.77	
Albion K. P. Welch "	5,000.00	
Stanton Blake "	5,000.00	
McGregor "	2,500.00	
Katharine B. Lowell "	5,000.00	
Samuel E. Sawyer "	4,414.66	
		429,393.90

The income of the following is used towards paying salaries: —

Nathaniel Thayer, for Professorship of Physics	25,000.00	
Jas. Hayward, for Professorship of Engineering	18,800.00	
William P. Mason, " Geology	18,800.00	
Henry B. Rogers, for General Salaries	25,000.00	
		87,600.00

SCHOLARSHIP TRUSTS.

Richard Perkins Fund	53,175.17	
James Savage Fund	13,252.82	
Susan H. Swett Fund	10,182.95	
William Barton Rogers Fund	10,374.27	
Joy Fund	9,123.70	
Elisha Thacher Loring Fund	5,329.39	
Charles Lewis Flint Fund	5,253.93	
Thomas Sherwin Fund	5,000.00	
Farnsworth Fund	5,000.00	
James H. Mirrlees Fund	2,675.78	
William F. Huntington Fund	5,208.33	
T. Sterry Hunt Fund	3,082.74	
Elisha Atkins Fund	5,000.00	
Nichols Fund	5,000.00	
Ann White Vose Fund	53,232.36	
Dalton Grad. Chemical Fund	5,090.00	
		195,981.44

OTHER TRUSTS.

Charlotte Billings Richardson, Industrial Chemistry Fund	37,378.78
Susan Upham Fund	1,192.47
Susan E. Dorr Fund	2,672.65
William Hall Kerr, Library Fund	2,000.00
Biological Instrument Fund	500.00
Mathematical Department Fund	250.00
Charles Lewis Flint, Library Fund	5,000.00
Rotch Arch. Library Fund	5,000.00
Rotch Architectural Fund	25,000,00
Arthur Rotch Prize Fund	5,225.00
Arthur Rotch " Special " Prize Fund	5,225.00
Letter-Box Fund, balance	170.12

MISCELLANEOUS.

Notes Payable	150,000.00	
Students' Deposits	500.00	
Catherine P. Perkins Legacy, 1893	102,781.40	
Henry E. Hutchins Legacy, 1895	2,000.00	
Moses Kimball Legacy, 1896	5,000.00	
Benjamin P. Cheney Legacy, 1896	10,000.00	
Susan G. Coolidge Devise, 1896	14,500.00	
M. I. T. Stock Account	682,401.19	
		967,182.59
		$1,769,771.95

Comparative Statement of Funds, etc.

	Sept. 30, 1895.	Sept. 30, 1896.
Trusts for general purposes	424,979.24	429,393.90
" " Salaries	87,600.00	87,600.00
" " Scholarships	137,014.11	195,981.44
" " Library	5,000.00	7,000.00
Charlotte B. Richardson Ind. Chem. Fund	37,378.78	37,378.78
Letter-Box Fund	59.12	170.12
Notes Payable	150,000.00	150,000.00
Students' Deposits	600.00	500.00
Martha Ann Edwards Legacy	98,452.89	
T. O. H. P. Burnham "	20,000.00	
Catherine P. Perkins "	96,213.00	102,781.40
William J. Walker "	21,136.00	
Susan Upham Fund	1,141.12	1,192.47
Susan E. Dorr Fund	2,557.56	2,672.65
Henry E. Hutchins Legacy		2,000.00
Moses Kimball "		5,000.00
Benj. P. Cheney "		10,000.00
Susan G. Coolidge Devise		14,500.00
Biological Instrument Fund		500.00
Mathematical Department Fund		250.00
Rotch Architectural Fund	25,000.00	25,000.00
Rotch Architectural Library Fund	5,000.00	5,000.00
Arthur Rotch Prize Fund	5,000 00	5,225.00
Arthur Rotch "Special" Prize Fund	5,000.00	5,225.00
M. I. T. Stock Account	540,462.03	682,401.19
	$1,662,593.85	$1,769,771.95
Increase		
Consisting of: —		
Bequests for Special Purposes, etc. See page 84		63,150.65
Gifts and Bequests for General Purposes. See page 84		42,483.06
Income more than Expenses		2,350.27
		107,983.98
Less Scholarship Funds, 1895, used	705.88	
" Students' Deposits	100.00	
		805.88
		$107,178.10

INCOME FROM GENERAL INVESTMENTS, AND APPLICATION THEREOF.

Applied to Salaries	3,942.00	From Dividends, Bank Stocks	1,080.00
" " Scholarships	4,269.12	" State Tax returned on Bank Stocks .	242.59
" " " James Savage Fund .	400.00	" Bonds	9,221.12
" " Charlotte B. Richardson Fund . .	1,682.04	" Dividends, Railroad Stocks	2,678.00
" " Library	495.00	" " Coal and Gas Stocks . .	1,910.00
" " General Purposes	9,187.60	" " Manufacturing Stocks .	1,248.00
" " Increase of Funds	1,761.68	" Real Estate Stocks	126.00
" " Advances to Bond Premiums . .	533.90	" Interest allowed on Funds not in Bonds and Stocks @ 4½ %	5,765.63
	$22,271.34		$22,271.34

INCOME FROM WILLIAM BARTON ROGERS MEMORIAL FUND, AND APPLICATION THEREOF.

Paid Massachusetts Institute of Technology .	9,570.09	Received Income from Railroad Bonds . . .	10,091.50
Credited to Advances Bond Premiums . . .	521.41		
	$10,091.50		$10,091.50

DETAILS OF SOME ITEMS IN TREASURER'S CASH ACCOUNT.

Rents.

Huntington Hall, for Lowell Lectures			3,500.00	
Lowell School of Design			1,800.00	
Chauncy Hall School, for Gymnasium			400.00	
State Board of Health, for use of Laboratories			750.00	
Land and Building, Clarendon St., on account			4,750.00	
34 Commonwealth Avenue, 1 year		2,200.00		
less Annuity under Will		1,000.00		
less Tax and Repairs		368.26		
		1,368.26		
			831.74	
Use of Rooms and Gymnasium			1,274.84	
				13,306.58

Department Supplies.

Chemistry		10,119.38	
Physics		7,981.90	
Mining		2,199.32	
Mechanical Engineering		2,779.24	
Naval Architecture		512.35	
Applied Mechanics		1,509.75	
Civil Engineering		2,724.56	
Biology		2,140.93	
Geology		907.19	
Architecture		2,147.24	
Drawing		38.75	
Mathematics		110.89	
English		1,381.43	
Workshops		1,614.68	
Modern Languages		134.54	
Periodicals		1,262.84	
			37,564.99

Salaries.

Instruction	178,445.40	
Administration	20,165.91	
Labor	18,417.27	
		$217,028.58

Repairs.

Department Improvements: —			
Chemistry	1,679.93		
Mechanical Engineering	720.43		
Physics	370.24		
Workshops	297.86		
English	281.92		
Civil Engineering	226.79		
Mining	191.92		
Biology	166.13		
Applied Mechanics	125.72		
Geology	89.11		
Mathematics	79.17		
Architecture	29.30		
Modern Languages	5.62		
Naval Architecture	5.30		
Drawing	1.87		
		4,271.31	
Rogers Building		1,170.50	
Walker "		954.67	
Sundries		821.36	
Steam Fitting		778.75	
Architectural and Engineering Buildings		686.46	
Gymnasium		399.57	
Boilers, Tools, etc.		145.00	
Ventilation, Huntington Hall		112.80	
Lowell School of Design		31.25	
General Library		25.88	
Military Department		5.62	
			$9,403.17

General Expenses.

Electric Wiring	2,148.85	
Stationery and Office Supplies	1,789.40	
Fire Insurance	1,683.20	
Postage	1,173.00	
Entrance Examinations	868.22	
Sundries	808.03	
Diplomas, Commissions, and Expense of Drill	732.07	
Washing	713.13	
Furniture	558.73	
Janitor's Supplies: Brushes, Pails, etc.	462.63	
Express Charges, Teaming, etc.	429.23	
Window Shades	402.39	
Lowell School of Design	387.82	
Gymnasium Supplies	377.42	
Examination Books	287.50	
Paints, Varnish, etc.	239.47	
Ice	237.48	
Engine Room Supplies: —		
Oil	153.12	
Cotton Waste	69.65	
	222.77	
Amount carried forward	$13,521.?	

Amount brought forward	13,521.34	
Transformer for Physical Department . . .	214.95	
Books, Supplies, etc., for General Library . .	193.90	
Mechanics' Fair, Atlanta and Swedish Exhibits	150.47	
Tennis Court	99.89	
Type-Writing Machine	97.60	
Glass	87.11	
Telephone & Telegraph Co.	85.58	
Military Department	83.62	
Union Safe Deposit Vaults	50.00	
Western Union Telegraph Co	27.00	
Legal Fees	20.00	
		$14,631.46

BOSTON, Dec. 4, 1896.

An examination of the accounts of the Treasurer of the MASSACHUSETTS INSTITUTE OF TECHNOLOGY for the year ending Sept. 30, 1896, has been made, and they are found to be correctly cast, and with proper vouchers. The ledger balances agree with the trial balance. We have verified the evidences of personal property held by the Institute.

C. C. JACKSON,
JAMES P. TOLMAN,
CHARLES FAIRCHILD,
Auditing Committee.

MASSACHUSETTS INSTITUTE OF TECHNOLOGY.

ANNUAL REPORT

OF THE

PRESIDENT AND TREASURER,

DECEMBER 8, 1897.

BOSTON:
ROCKWELL AND CHURCHILL PRESS.
1898.

Members of the Corporation.

President.
JAMES M. CRAFTS.

Secretary.
FRANCIS H. WILLIAMS.

Treasurer.
GEORGE WIGGLESWORTH.

JOHN D. RUNKLE.
FREDERIC W. LINCOLN.
WILLIAM ENDICOTT, JR.
JOHN CUMMINGS.
AUGUSTUS LOWELL.
HOWARD A. CARSON.
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CHARLES FAIRCHILD.
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ALEXANDER S. WHEELER.
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ELIOT C. CLARKE.
NATHANIEL THAYER.
CHARLES F. CHOATE.
HIRAM F. MILLS.
PERCIVAL LOWELL.
ARTHUR T. LYMAN.
CHARLES MERRIAM.
THORNTON K. LOTHROP.
CHARLES C. JACKSON.
SAMUEL M. FELTON.
DESMOND FITZGERALD.
SAMUEL CABOT.
FRANCIS BLAKE.
CHARLES W. HUBBARD.
THOMAS L. LIVERMORE.
A. LAWRENCE ROTCH.
JOHN R. FREEMAN.
GEORGE A. GARDNER.
WILLIAM H. LINCOLN.
J. B. SEWALL.
THOMAS GAFFIELD.
CHARLES L. LOVERING.
A. LAWRENCE LOWELL.
SAMUEL JOHNSON.
JAMES P. MUNROE.
WILLIAM L. PUTNAM.
CHARLES G. WELD.

On the Part of the Commonwealth.

HIS EXCELLENCY GOV. ROGER WOLCOTT.
HON. WALBRIDGE A. FIELD, *Chief Justice of the Supreme Court.*
HON. FRANK A. HILL, *Secretary of the Board of Education.*

Committees of the Corporation.

Executive Committee.

JAMES M. CRAFTS.
GEORGE WIGGLESWORTH. } *Ex Officiis.*

FRANCIS H. WILLIAMS. AUGUSTUS LOWELL.
THOMAS L. LIVERMORE. ALEXANDER S. WHEELER.
HOWARD STOCKTON.

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WILLIAM ENDICOTT, Jr. CHARLES C. JACKSON.
DAVID R. WHITNEY. NATHANIEL THAYER.
SAMUEL JOHNSON.

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HOWARD A. CARSON. GEORGE A. GARDNER.
HIRAM F. MILLS.

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PERCIVAL LOWELL. JOHN D. RUNKLE.
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Auditing Committee.

CHARLES C. JACKSON. JAMES P. TOLMAN.
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Committee on Nominations.

AUGUSTUS LOWELL. FREDERIC W. LINCOLN.
HOWARD STOCKTON. DAVID R. WHITNEY.
GEORGE A. GARDNER.

Trustees of the Museum of Fine Arts.

FREDERIC W. LINCOLN. JAMES M. CRAFTS.
A. LAWRENCE ROTCH.

Visiting Committees.

Department of Civil Engineering.

HOWARD A. CARSON. ELIOT C. CLARKE.
CHARLES F. CHOATE. DESMOND FITZGERALD.
JOHN R. FREEMAN.

Departments of Mechanical Engineering and Applied Mechanics.

HIRAM F. MILLS. FRANCIS BLAKE.
DESMOND FITZGERALD. JAMES P. TOLMAN.

Departments of Mining and Geology.

THOMAS L. LIVERMORE. JAMES P. TOLMAN.
CHARLES FAIRCHILD. CHARLES L. LOVERING.

Department of Architecture.

THORNTON K. LOTHROP. JOHN R. FREEMAN.
ELIOT C. CLARKE. A. LAWRENCE ROTCH.

Department of Physics and Electrical Engineering.

FRANCIS BLAKE. A. LAWRENCE ROTCH.
CHARLES W. HUBBARD. DESMOND FITZGERALD.

Departments of Literature, History, and Political Economy.

FRANK A. HILL. CHARLES C. JACKSON.
J. B. SEWALL. A. LAWRENCE LOWELL.
JAMES P. MUNROE.

Department of Modern Languages.

J. B. SEWALL. NATHANIEL THAYER.
FRANK A. HILL. THORNTON K. LOTHROP.

Department of Mathematics.

PERCIVAL LOWELL. HOWARD A. CARSON.
HOWARD STOCKTON. WILLIAM L. PUTNAM.

Departments of Chemistry and Biology.

SAMUEL CABOT. THOMAS GAFFIELD.
FRANCIS BLAKE.

Department of Chemical Engineering.

ARTHUR T. LYMAN. SAMUEL CABOT.
HIRAM F. MILLS. CHARLES W. HUBBARD.

Department of Naval Architecture.

CHARLES J. PAINE. WILLIAM H. LINCOLN.
HOWARD STOCKTON. CHARLES G. WELD.

To the Corporation of the Massachusetts Institute of Technology:

Not long after President Walker had read to you the report of last year, he was taken from us with tragic suddenness; and you have in mind the final report of the great sum of his life's work which has been made at our memorial meeting. He has left us a house in order; and his own words in speaking to this Corporation of the sudden death of his predecessor may serve as a fitting tribute to himself: "This man whom we honored and loved, to whom we looked up as to master, teacher, father, fell, an unfinished sentence on his lips, instantly dead in our midst. At the time, in the act, it seemed to every spectator a tragedy replete with all the elements of terror and of grief; yet to me, at least, even before that stately and beloved form was laid in the grave, the whole character and bearing of the event had undergone a transformation. I saw that only a scaffolding had fallen, revealing to the view the sublime perfection of a truly finished life."

During the last year death has taken four members from the Corporation, Henry L. Pierce, Lewis William Tappan, Jr., Henry D. Hyde, and William H. Forbes.

Mr. Pierce was a member of the Committee on the Society of Arts from 1885 to 1891, and of the Committee on Literature, History, and Political Economy from 1885 to 1894. Resolutions commemorative of his character and services stand upon our records. His good-will towards this Institute was shown by the part which he took in our councils during the engrossing cares of a very busy and useful private and public life, and also by large donations. At his death the Institute became the recipient, together with Harvard College and three other public institutions, of his residuary estate,

beside a legacy of fifty thousand dollars. This bequest was without restrictions as to use, and the estate under skilful management has proved so large that the general fund bearing interest for the unrestricted use of the school will be doubled.

Mr. Tappan was at first Bursar of the Institute, and upon Mr. Cummings' resignation he became Treasurer. He held during a part of this time the office of Secretary of the Corporation. In 1891 he retired from the office of Secretary; and General Walker, in expressing the regret of the Corporation, says that he had acquired in the several offices filled by him an intimate knowledge of the school, its history, organization, traditions, methods, such as is possessed by no other member of the Corporation. This knowledge of our requirements, together with his zeal and devotedness, made him a most valuable, as he was an indefatigable, aid in advancing the interests of the school.

Col. William Hathaway Forbes became a member of the Corporation in 1893 after the resignation of his father, our early, constant, and liberal benefactor, and long a member of this body. Colonel Forbes' interest in the school was promoted not only by family associations, but also by his own intimate connection with one of the most successful enterprises for the application of science to industry, the Bell Telephone Company. He was also, by his tastes for yachting, well qualified to advise with the department of naval architecture, which was founded during his first year of service on our Corporation.

Failing health has compelled the resignation from the Executive Committee of Mr. John Cummings, who for thirty-four years has served and befriended us with enthusiastic devotion, upon the Executive Committee and as Treasurer; he has given us a large measure of his time and thoughts, and the resolutions passed by this body testify that at the moment of our greatest need he pledged his personal credit to support that of the school. Mr. Cummings stands foremost

among the men who have founded and sustained this Institute during its trial years.

While giving an account of the events of the school year since I assumed the duties of Chairman of the Faculty, January 13, 1897, and those of the Presidency, October 20, 1897, it is fitting to say that a new task has been rendered as little burdensome as possible by the custom of the institution, since its foundation, to entrust many questions of regulation of studies and of policy to the initiative of the Faculty. The members of different sections have always taken a leading part in shaping the growth of their departments, and a habit of hearty coöperation has grown up, which has stood us in good stead in our present emergency.

The maintenance of the total number of students may be considered as a proof of the confidence of the public in the permanent character of our institution.

The entering class is this year 318. In the three preceding years the first-year classes were 332; 320; 320.

The proportion of students who are candidates for a degree has tended to increase slightly during the last few years, and after the elimination during the first year of those who are not qualified to remain in regular standing, the classes of the succeeding years maintain their strength, losing some of their members and recruiting others from the ranks of special students and from other colleges.

The first year is avowedly a trial year, and we have been encouraged by past experience to maintain our policy of examination requirements, which do not exclude pupils from many of the less well-equipped high schools. Young men of good capacity and industry, who have not had the advantage of the best preparatory training, are often fitted during this year to take equal rank with more fortunate comrades, and native ability and the new habits of study acquired may lead them to the foremost places. It may be added that the test of adaptability to the methods of study peculiar to

scientific training sometimes reverses during the first term the verdict of entrance examinations. The methods of the scientific school are often different from those of the preparatory school, and a clever student who has succeeded in his early studies may not have the turn of mind which leads to success in science. The difference between a scholar and an observer is sometimes an insurmountable difference of mental qualities. The quality and quantity of work to be done are continually under revision by the Faculty. The standard of work leading to a degree is fixed by what we deem fair exertion for an intelligent and industrious student. On the one hand we wish in the interest of our graduates to maintain the highest possible value of the diploma, and on the other we seek to bring the requirements within the capacity of the largest number. It is well understood that no one is obliged to overtax his powers in a race for a degree in the regular four-years courses. The same end may be attained in a five-years course, and those who for any reason do not wish to pursue the regular studies can obtain in special courses the kind of education which they elect, under the careful supervision of the Faculty.

Better preparation is continually offering us a more advanced starting point, and progress in scientific methods in some instances is tending to shorten study hours, so that we may hope to raise the standard for our diploma without increasing the amount of work done in the school. The earnest solicitude of the whole instructing staff is directed towards improving the quality of the work.

The crowded condition of our laboratories and drawing-rooms makes it difficult for us to offer to students the inducements we could wish to remain and take the Master's degree. The number last year, eleven, was equal to the total of the three preceding years; and it is to be hoped that this very small beginning marks a movement in the right direction. Great influence is exerted upon his comrades by a student, who has acquired a love for science, who,

before entering upon professional work, gives himself a respite of a year or two to work out under the direction of a professor some more abstruse problems of theory or of practice. Such a man becomes a valuable auxiliary to the teaching force of the school, and the presence of large numbers of graduate students in some of our universities has contributed more than anything else to raise the character of their instruction toward the level of the older institutions of Europe.

These are some of the considerations which have guided us in dealing with educational problems, and they may serve as a preface to the description of the progress which we have made thus far in our methods of instruction.

Each year's report brings new demands for increased space. The drawing-rooms for civil engineering have one-half more students than ever before. The mechanical engineering rooms are overfilled with machinery, and too large a number of students are detailed to each machine. The chemical laboratories are filled to their utmost capacity. The mining department has a new class much larger than ever before. Important researches in biology are postponed for want of space. In other words, without any increase in the total number of students, the growing laboratory requirements of the upper classes make our accomodations each year less adequate. Our teaching continually advances in the direction of a greater subdivision of classes. The work is done under the supervision of instructors by small sections, whose principal business it is to make laboratory experiments, to test machinery at work, or to make drawings representing projects of construction in engineering or architecture. It is in this direction of subdivision and minute supervision that we are seeking to improve the quality of our work, and for this reason more teachers and larger space have to be provided for a given number of students.

I desire also to present to your consideration a new feature of these embarrassing evidences of prosperity, that is, the

probable fluctuations of the demands. The thirteen courses have been successively instituted to correspond with the new fields which science has opened to the arts, and to the demands which new industries are making upon science; and the changes in the numbers of students who are taking different courses are the measure of the popular conception of these demands for skill in some particular branch of technology. To a considerable extent these requirements are rightly understood. They are often guided by the inquiries for suitable assistants from men who have made places for themselves in the industrial world, and who are opening new positions to younger men. We cannot tell whether the success of American engineers in South African mines is one of the threads which draw a number of mining students to a Boston school. We cannot take up such a question from a commercial standpoint; but we do know that such varying demands will be made upon an industrial school, and until we have greatly enlarged our buildings, we shall be put each year to temporary expedients to meet yearly exigencies, and the Treasurer will inform you that such changes involve large expenses.

It will be long before we can hope to leave behind us the anxieties of such problems, and it should be said, moreover, that, although the condition described has often been one of great discomfort, it has never been allowed to impair the efficiency of the school. We are less favored than many neighboring institutions in building-space, but we have always followed the wise policy of keeping in the foremost rank, and in some departments leading the way in supplying the best models and apparatus for teaching and for making investigation. We have run in debt to buy them, and then run still further in debt to build houses to hold them, but we have always had them when the head of a department told the government of the school that they were necessary to the most effective teaching of his science. We now find ourselves working elbow to elbow, with the best tools, but with no room to spare, and with no margin of space to meet

change of demands. Perhaps this state of things, like the discomfort of a crowded theatre, has contributed to keep alive enthusiasm; it certainly has made evident that we were not misapplying the funds so nobly contributed for the support of the school. Each dollar at interest, or invested in land or buildings, has had its educational value, and these things were the best witnesses which we could bring before the Legislature to justify a generous grant of public money — twenty-five thousand dollars per annum donated to us for six years in January, 1895.

During next year, legacies, which do not yet appear as paid in the Treasurer's account, will allow us to put up in the spring the new building described in much detail in General Walker's report of last year, and the only shadow upon our great satisfaction is the thought that he could not live to see realized what he speaks of as "the pleasant dream in which the Executive Committee and Faculty indulged themselves until rudely awakened by the impossibility of securing the necessary funds under the painful industrial and commercial conditions prevailing the past season."

Legacies and Gifts. — The payment of the Pierce bequest will not take place until the first of next year, but we have had a large accession to our funds during the current year. Fifty thousand dollars has been allotted to our Institute by the trustees of the John W. and Belinda L. Randall Charities Corporation, with the condition that the sum shall be set apart and used in a manner commemorative of John W. and Belinda L. Randall. This legacy is a portion of a sum of $350,000 placed in the hands of the trustees to be donated for charitable and educational purposes, and the donation allotted to the Institute is most gratefully received. The trustees have in this substantial manner recognized our claims as an educational institution worthy of many-sided support.

Mrs. William B. Rogers has continued her welcome contribution to our library fund, presenting us with two hundred

dollars for the purchase of periodicals. Other friends of the Institute have contributed a total sum of nine hundred and twenty-five dollars for various purposes.

The Libraries.

The total number of accessions is 3,743. Of these, 1,229 were obtained by purchase, 916 by binding periodicals and books received in parts, and 1,598 by gift. Deducting from the total accessions books counted twice, and books removed from the shelves or lost, the total net additions are found to be 2,974 volumes, 533 pamphlets, and 126 maps, making the grand total 3,633. The following table shows the net accessions in each of the libraries of the Institute and the amount expended for the same by the departments, together with the total contents of each on Sept. 30, 1897. To a certain extent the pamphlets are counted twice, for according to the custom established in previous reports a collection of pamphlets bound together in one volume is counted as one in the list of volumes, and at the same time each pamphlet is counted as one in the list of pamphlets. Until the end of the period covered by this report the Libraries of Military Science, Mathematics, and Modern Languages were regarded as part of the General Library, although the books have been kept in separate rooms. Hereafter they will be treated as distinct libraries, and this change is the cause of certain irregularities which will be noticed in the following table:

TABLE OF NET ACCESSIONS, 1896-97, SHOWING COST OF SAME, AND TOTAL CONTENTS OF THE LIBRARIES OF THE INSTITUTE, SEPT. 30, 1897.

LIBRARIES.	NET ACCESSIONS.			Cost Department.	TOTAL CONTENTS.	
	Volumes.	Pamphlets.	Maps.		Volumes.	Pamphlets and Maps.
Engineering (C.E., M.E., & N.A.)	611	105	93	$982.53	7,282	3,319
Mining	217	20	..	249.52	1,903	323
Architecture	151	4	..	526.19	2,030	185
Chemistry	391	40	..	509.03	6,956	1,477
Biology	148	23	..	226.23	1,950	374
Physics	311	13	..	701.99	5,696	669
Political Science. (Econ. & Hist.)	587	66	..	491.65	8,560	3,041
English	89	..	..	145.00	2,273	36
Military Science	..	..	..	....	98	....
Geology	98	11	33	90.68	1,765	805
Mathematics	..	..	..	....	540	113
Modern Languages	..	..	..	....	565	....
General Library	347[1]	251[1]	..	259.25[1]	3,798[2]	3,250[2]
Margaret Cheney Room	24	..	..	..	599	13
Totals	2,974	533	126	$4,182.07	44,015	13,605

[1] Including Military Science, Mathematics, and Modern Languages.
[2] After deducting Military Science, Mathematics, and Modern Languages.

From this table it will be seen that the libraries of the Institute contained at the end of the fiscal year, in all, 44,015 volumes and 13,605 pamphlets and maps.

The periodicals regularly received form one of the most valuable features in the yearly increase of the libraries. The following table shows the number and probable cost of the publications of this kind which are received regularly, including such official reports as are listed in the published catalogue of periodicals received in the libraries of Boston:

TABLE OF PERIODICALS AND OTHER SERIAL PUBLICATIONS, 1896–97. SHOWING THE NUMBER AND ESTIMATED COST OF THOSE RECEIVED FOR EACH DEPARTMENT, AND OF THOSE CHARGED TO EACH ACCOUNT.

LIBRARIES.	NUMBER RECEIVED.					ESTIMATED COST.			
	Gifts.	Dept. Acct.	Periodical Account.		Totals.	Dept. Acct.	Periodical Account.		Totals.
			T.Q.	Subs.			T.Q.	Subs.	
Engineering (C.E., M.E., & N.A.)	51	14	64	44	173	$42.41	$153.60	$185.58	$381.59
Mining	12	1	20	22	55	1.79	48.00	76.91	126.70
Architecture	3	...	4	24	31	....	9.60	139.78	149.38
Chemistry	88	10	14	42	154	36.81	33.60	108.95	179.36
Biology	23	6	7	29	65	21.10	16.80	183.29	221.19
Physics	12	1	28	28	69	.85	67.20	135.81	203.86
Political Science (Econ. & Hist.)	55	24	6	74	159	49.91	14.40	212.09	276.40
English	....	....	....	8	8	....	....	27.09	27.09
Military Science	2	...	.. .	2	4	....	....	3.50	3.50
Geology	19	1	9	6	35	....	21.60	29.95	51.55
Mathematics	1	....	2	13	16	....	4.80	46.45	51.25
Modern Languages	...	1	1	2	4	6.00	2.40	9.60	18.00
General Library	44	....	14	12	70	....	33.60	26.90	60.50
Lowell School of Design	....	....	....	4	4	....	....	11.25	11.25
							$405.60	$1,197.15 405 60	
Totals	310	58	169	310	847	$158.87		$1,602.75	$1,761.62

The periodical account is charged with the periodicals received in exchange for the Technology Quarterly, as well as with those for which cash subscriptions are paid. For each copy of the Technology Quarterly sent in exchange for the periodicals the Society of Arts is credited with $2.40 annually, the wholesale price, and the Periodical Account is charged with a like sum, as indicated in the columns "T.Q." in the foregoing table. The table shows that 847 periodicals and other serial publications are received regularly, besides a large number of official reports that have not been counted.

The expenditures for the year on account of the libraries, exclusive of salaries, may be summarized as follows:

Paid by departments for books and binding,		$4,182.07
Periodical account, subscriptions . . .	$1,227.78	
Technology Quarterly for exchanges . . .	476.80	
		1,704.58
Expense account, libraries		218.81
Total		$6,105.46

There were sent out during the year 1,246 orders for new books. One hundred and twenty-one duplicate orders were returned to heads of departments, and of these only 23 were reordered. For binding and lettering there were given 1,014 separate orders amounting to 1,484 volumes, costing in the aggregate about $1,285.68. There were added to the main catalogue 2,416 cards, but in the process of uniting several lists heretofore kept separate, 175 duplicate cards were removed. The total number of cards in the main catalogue is now 39,673. We have received for inspection 253 foreign books, of which 100 were purchased. From the Chemical Library 1,893 books were borrowed for home use. Records were not kept in the other libraries, but the indications are that they were used fully as much as this one.

Of the 1,598 volumes and pamphlets received as gifts, the following books are especially worthy of notice: From Mrs. Henry Draper, of New York, parts of Stegmann's Architektur der Renaissance in Toscana; Robida, Le Cœur de Paris; Harper's Pictorial History of the Rebellion; Piranesi, Della magnificenza e d'architettura de' Romani, 1761; Piranesi, Le antichità Romane; the second volume of Sachs' Modern Opera Houses and Theatres; and Comptes Rendus de l'Academie des Sciences de Paris; from His Highness the Maharaja of Jeypore, six volumes of the beautiful Jeypore portfolio of architectural details; from Mrs. William B. Rogers, 8 copies of her Life and Letters of William Barton Rogers, and 42 volumes, chiefly from the library of her father, Hon. James Savage; from Prof. Charles Sedgwick Minot, 20 volumes on engineering subjects; from W. O.

Ross, Esq., 32 volumes, chiefly on physics; from Miss Julia Delano, of New Bedford, 6 volumes on the early history of the steam-engine. Professor Bates, Professor Talbot, Professor Gill, and Dr. Whitney have presented the Institute with copies of their published writings.

Changes in the Faculty and the Corps of Instruction.

Assistant Prof. Arthur A. Noyes, S.B., Ph.D., has been promoted to be Associate Professor of Organic Chemistry.

The Faculty has been reënforced by the following promotions from the corps of instructors: namely, Harry M. Goodwin, S.B., Ph.D., to be Assistant Professor of Physics; Frank A. Laws, S.B., to be Assistant Professor of Electrical Measurements; John O. Sumner, A.B., to be Assistant Professor of History.

Dr. Noyes graduated at the Institute in 1886; continuing his studies for an additional year, he obtained the degree of Master of Science, and became an Assistant in Analytical Chemistry. In 1888 he went to Europe and studied under Ostwald at Leipsic, obtaining his doctorate in 1890. Returning to the Institute in that year, he was appointed Instructor in Analytical Chemistry. The following year he was transferred to the department of Organic Chemistry, where he has served the Institute with distinguished success. In 1894 he was appointed Assistant Professor of Organic Chemistry. The reports of the successive years since his graduation contain the titles of a very interesting series of papers on physico-chemical subjects which he has studied with unwearying industry and success.

Mr. Laws graduated from the Course in Electrical Engineering at the Institute in 1889, and began his duties as Assistant in the Physical Laboratory in the following autumn. His work gradually came to be directed more especially toward electrical testing, in which he showed marked ability. In 1891 he received the appointment of Instructor in Physics,

and in 1894 that of Instructor in Electrical Measurements. Upon the withdrawal of Professor Holman from active participation in the work of the electrical laboratory the immediate care of the instruction in electrical testing devolved upon Mr. Laws, who also assumed the course of lectures upon electrical measuring instruments and methods. These courses have been greatly extended under his direction.

Mr. Laws has published a number of original papers relating to electrical instruments and testing, and the magnetic properties of iron, in the Proceedings of the American Academy, the Technology Quarterly, and elsewhere. He is at present engaged in the preparation of a set of notes on electrical measuring instruments, which, when completed, will fill a gap in this field and be of great service to our students, for whom they are especially designed.

Dr. Goodwin graduated from the Course in Physics at the Institute in 1890, and was appointed Assistant in Physics at that time. In 1892 he received the appointment of Instructor in Physics, and was then granted leave of absence in order that he might prosecute his studies in Germany. He remained there for two years, devoting himself especially to the study of physical chemistry at Leipsic with Professor Ostwald, and was awarded the degree of Ph.D. with the highest honors. On his return at the beginning of the school-year 1894–5 he took charge of the instruction in general physical measurement. Through his efforts this course has been much strengthened. The laboratory of physical chemistry was also established at his instance, and the entire course of instruction in this new and important branch has been planned and carried out by him.

Dr. Goodwin has made various original researches, especially upon physico-chemical subjects, which have been published chiefly in the Zeitschrift für Physikalische Chemie, the Physical Review, and the Technology Quarterly.

Mr. Sumner graduated at Harvard College in the class of 1887. He spent five years in European study and travel,

devoting himself chiefly to mediæval history, literature, and art. The report of 1894 makes mention of Professor Sumner's courses of instruction in the political history of the United States and of England, and the history and literature of the Renaissance and Reformation. The department of architecture has hitherto depended upon outside lecturers for the treatment of the history of painting and sculpture. This instruction is now in the charge of Professor Sumner, and has gained in regularity and importance. He collected, during last summer, in Europe, an excellent series of photographs and slides; these, together with slides prepared by Professor Lawrence, have been used with excellent effect to illustrate the lectures.

Professor Holman's ill health has withdrawn him from active work, although not from participation by his counsels in our plans for the best interests of the school. He has been appointed Professor of Physics Emeritus.

Professor Silas W. Holman graduated from the Institute in 1876, and was immediately thereupon appointed Assistant in the Physical Laboratory, but on account of illness he did not begin his actual duties until a year later. In 1880 he was advanced to the grade of Instructor; in 1882 he received the appointment of Assistant Professor; in 1885 that of Associate Professor, and in 1893 that of Professor of Physics. He has thus been connected with the Institute as a member of its staff of instruction for twenty-one years.

During the whole of his active service Professor Holman has devoted himself most earnestly to the building up of the work of the Physical Laboratory, and in later years more especially to the work in electrical and heat measurements. From the beginning he showed a rare capacity for accurate physical work, and a healthy intolerance of any other than such work on the part of a student. To this was coupled a fine appreciation of the relative value of different methods of solving a physical problem, high experimental skill in carrying out a physical research, and much inventiveness in the

adaptation of special methods to general laboratory use. These qualities, with his steady faithfulness to the highest interests of the Institute, have made his influence of such a character that it cannot be too highly estimated.

Professor Holman's publications all give evidence of the characteristics which have been referred to. The Physical Laboratory Notes printed by the Institute for the use of its students, and especially the part devoted to electrical measurements, stand far apart from other publications of like character in the clear manner in which the particular adaptation of each process is set forth, and the distinct recognition of the limits within which each is applicable. Though not great in bulk, they embody the results of years of teaching, and the experiments are so well selected and arranged that a student gains infinitely more by the performance of a limited number of them, with the scrupulous care which they require of him, than by a much more widely extended course of less carefully planned exercises. Like good judgment and skill in arrangement are found in the volume on "Precision of Measurements," written by him for use of our students, and in a recently published collection of Logarithmic Tables, which has received high commendation both in this country and abroad.

Professor Holman had much skill in research, either when conducted by himself personally or by others under his direction. His thesis at graduation was published, and was immediately recognized as a paper of exceptional merit upon a difficult subject, the Viscosity of Gases. Other papers upon the same subject were published in subsequent years, and are of standard authority. To these he added researches of value upon thermometry, thermo-electricity, and electrical measurement, many of which were laid out as thesis subjects for advanced students in Physics and Electrical Engineering, and carried on under his direction, the last of them even after failing strength had compelled him to abandon the attempt at personal supervision of the experimentation.

From the time of his graduation Professor Holman had been hampered by a lack of robust health, and in later years a more serious impairment became manifest. A year's leave of absence, while helpful, served only to retard the progress of disease, so that he has been obliged gradually to relinquish his duties, and for the past two years has been unable to be present in the laboratory, though still ready to render valuable aid to his colleagues by suggestion and advice.

Professor Currier has been prevented by illness from taking his classes this term, and we miss his devoted services. It is hoped that he will be able to renew them next term. The work has been carried on without interruption, and we have fortunately been able to obtain a course of lectures on Comparative Politics from Professor Macvane, Professor of Ancient and Modern History in Harvard University.

Professor Bates is giving a course of lectures at Harvard University to supply the place of Professor A. S. Hill, now absent. This is not the first time that an interchange of services has taken place between the two institutions, and has proved of great convenience.

Mr. Charles T. Wentworth, A.M., has been appointed Instructor, and is now giving the course of lectures on European History to the second-year class. He was formerly a student of the Institute in Mining Engineering, and has since devoted himself to historical studies at the University of Wisconsin and at Harvard.

Mr. Henry M. Howe, A.M., S.B., Lecturer on Metallurgy, and a high authority on that subject, has accepted a call to the chair of Metallurgy at Columbia University. The good work he did with us for some ten years will be much missed, and the university to which he has gone is to be congratulated upon its acquisition of a professor who is at once so well informed a scholar and has so thorough a practical acquaintance with his special work.

Mr. Harry C. Bradley, S.B., of the class of '91, has been appointed Instructor in Mechanical Drawing and Descriptive Geometry.

The following Assistants of last year in the several departments named have been appointed Instructors: Carl H. Clark, S.B., '95, and Frederick A. Hannah, S.B., '95, in Mechanical Engineering; Charles M. Spofford, S.B., '93, in Civil Engineering.

The following Instructors have terminated their connection with the Institute: George W. Hamblet, on account of the demands of private business; G. Russell Lincoln, for travel and study in Europe; F. H. Robbins, to enter the employ of the Boston Water Board.

The following-named Assistants have been appointed for the current year:

Frederick L. Edmands, S.B., '97, in Mechanical Drawing; Myron L. Fuller, S.B., '96, in Geology; Charles N. Haskins, S.B., '97, and Nathan Hayward, S.B., '97, in Physics; George L. Hosmer and Francis H. Watts, S.B., '97, in Civil Engineering; Elbridge C. Jacobs, S.B., '97, in Mining Engineering; Walter B. Russell, S.B., '97, and James W. Smith, S.B., '97, in Mechanical Engineering; Robert G. Valentine, A.B., in English; Alpheus G. Woodman, S.B., '97, in Sanitary Chemistry; Lewis P. Chapin, Ch.E., in General Chemistry; William F. Hyde, in Forging; Herman W. Marshall, S.B., '97, and Percy G. Stiles, S.B., '97, in Biology.

Statistics of the Corps of Instructors.

The Catalogue of 1897–98 shows the number of instructors of all grades to be 132, inclusive of those concerned with the mechanic arts, but exclusive of those who are announced as lecturers for the year only. The addition of these raises the total to 158. The following table shows the distribution among the several classes of instructors, in comparison with last year:

	1896-97.	1897-98.
Professors	23	23
Associate Professors	7	8
Assistant Professors	21	23
Instructors	52	53
Assistants	24	25
Lecturers	26	26
Total	153	158

SCHOLARSHIPS.

As stated in the last Report, the scholarship resources of the Institute have been much increased by recent State legislation and by the bequest of Mrs. Ann White Vose. The available income at present amounts to more than $14,000, of which $8,000 is for State scholarships. In spite of this increase, the necessities of applicants on account of the general financial depression have fully kept pace with the increased income. The number of applicants for Institute scholarships for the present year has been 114, while 113 submitted applications for the forty State scholarships. Fifty-seven of these made applications in both places, leaving the total number of applicants considered by the Faculty and the State Board of Education 170. Of these 31 have received scholarships to the amount of full tuition; 79 others have received smaller amounts, averaging somewhat more than one hundred dollars each. The Treasurer receives returns to some extent from former beneficiaries of the Rogers Fund, but it does not appear that repayment is made to the full extent that it should be under the terms of the agreement.

The Students' Coöperative Society has taken this year a larger development than ever before. This society has not been mentioned in former reports, and it deserves a short notice. A body of students have organized themselves for administrative purposes with the kindly intent of facilitating the purchase of books, supplies, etc., within the buildings. Considerable time and attention has been given by the officers to making contracts, purchases, and sales. During vaca-

tion' preparations were made to have the requisite stock of materials on hand at the beginning of the term.

Two supply rooms have been conducted by the society, one in the Architectural Building and the other in the Engineering Building, both open daily during the term. Up to November 30 the total receipts of the society had amounted to $2,890.42, and it is estimated that the business for the year will exceed $5,000. It need scarcely be said that these arduous services are performed without remuneration by officers of the society, and that the incidental expenses for services are thus kept as low as possible. The society has been enabled to assist the scholarship committee of the Faculty this year to the extent of $650. But for this welcome aid a number of deserving students would have been unable to continue their work at the Institute.

The Y.M.C.A. Association.

The work of students belonging to this association, which was described in the last report, has been carried on with renewed energy this year. Fifteen hundred handbooks have been issued, so that each new student, or any one expecting to come to the Institute, is supplied with a guide to the headquarters of the association, where he can obtain directions regarding lodging places, as well as information regarding school work, tabular views, recitations, etc. About one hundred students have been directed to lodgings, and care has been exercised in making enquiries about the houses which were recommended, and in keeping informed about them. The annual reception to the new class gave an opportunity for a first general social meeting. Professor Niles made an address. The club-house which is occupied as headquarters and living rooms by the association has been successfully maintained. The house at 466 Massachusetts Avenue is open to the students, and monthly meetings are held there.

Entrance Requirements.

In his annual reports for 1894 and 1896 President Walker treated at considerable length the question of higher requirements for entrance, and gave strong reasons why no tasks should be imposed which should tend to raise the average of the age at which students are prepared to enter this school — at present nearly nineteen years. He thought that the high schools should be so equipped and officered as to give the necessary instruction within that limit of age. Our catalogue for this year announces the requirement, for 1898 and after, of one additional subject, which may be elected from among the following: Elementary Latin, Physics, Chemistry, Mechanical Drawing and Shopwork, additional French or German, English or History. It is hoped that the students will come to us with this added study completed within the above average limit of age. The question of additional requirements has been for a long time discussed by the Faculty, and the present requirement is expected to lead to various results of much interest.

On the one hand it emphasizes effectively the position long held by the Faculty, that no preparation is adequate which merely enables the candidate to pass the prescribed examinations. On the other hand, since it is not intended to hold examinations in the elective subjects, we are enabled to try an interesting experiment in regard to the use of teachers' certificates. The substitution of certificates for entrance examinations has been very extensively — and in some cases very successfully — employed. At this Institute, and in many other institutions of New England, examinations have been required to the entire exclusion of admission by certificate. The acceptance, in addition to our tests by examination, of teachers' certificates for elective subjects will give the secondary teachers a not unwelcome share in determining the eligibility of candidates, and will not, on the other hand, involve the risks incident to the unqualified adoption of the certificate system.

A series of questions in regard to entrance requirements, issued last year by a committee of the Massachusetts Association of Classical and High School Teachers, offered a welcome opportunity to define our position in regard to entrance requirements. A reply was prepared by a committee and submitted to the Faculty, and after very careful examination was approved and printed. A statement of certain principles determining the attitude and policy of the Institute was added, and the paper was distributed among secondary schools having relations with the Institute. Some of the main points of the statement were as follows:

1st. That it was not the intention of the Institute to make any such change in its requirements as should essentially enlarge the total amount of work of the secondary schools, or in any way to place its requirements above the range of work done by the public high schools.

2d. That the Institute is ready, as heretofore, to coöperate in any practicable plan for securing such a degree of uniformity in the requirements of colleges generally as is consistent with other important interests.

3d. That the object of the entrance requirements of the Institute is the best practicable discrimination between fit and unfit applicants for admission, and not the reconstruction of the secondary school curriculum.

4th. That any material increase in the present average age of entrance would be a serious misfortune.

5th. That it is for the best interest of secondary schools generally that requirements should be within the reach of their four-years courses, even if it is thereby rendered possible for individual applicants from particular schools, by narrowing their courses, to meet the requirements in three years, instead of four.

The reply of the Faculty was cordially received by the Association, and is believed to have commended itself to a large proportion of those most interested.

Another valuable opportunity for promoting closer rela-

tions between the Institute and secondary schools occurred somewhat later in the spring. The statement of our new requirements was presented, for suggestions and criticism, to some twenty representative secondary school teachers, mainly of eastern Massachusetts, and an informal conference with a committee of the Faculty was held at the rooms of the Technology Club. The interest shown, the nearly complete attendance of teachers invited, and the time given by them to thorough discussion of the numerous and important questions raised, were exceedingly gratifying. Important modifications were made in the report of the committee, which has now been adopted by the Faculty and incorporated in the Catalogue for the current year. It is hoped that future conferences of this kind may be held with equal success.

SUMMER SCHOOLS.

Geodesy, Topography, and Hydraulic Engineering. — The summer school for field work in geodesy, topography, and hydraulics was held during the month of June at Machias, Me., the same place where the school of last year was held. This was the ninth summer school of the Civil Engineering Department. It is an optional course, open to the third-year students in Civil Engineering, enabling them to get valuable practice which they would not otherwise obtain. Eight students were in attendance this year, a smaller number than usual, but the weather was favorable, and the amount of work accomplished was larger than in the year previous. Instruction was given by Professors Burton, Porter, and Robbins, assisted by Mr. Henry E. Warren, a graduate of the Institute in the class of '94, and Mr. George L. Hosmer, of the class of '97.

The work, as usual, consisted mainly of field work during a period of about three weeks. Some very interesting experiments were made in connection with the use of the thermophone in determining the coefficient of expansion of the 100 meter steel tape used in base-line measurements.

These experiments were carried on under the direction of Mr. Warren, one of the inventors of the thermophone, and the results will be published in some future number of the Technology Quarterly.

Several of the old Coast Survey stations were reoccupied, signals were erected, and practice was given in measuring and adjusting the angles in a scheme of triangulation. Plane table surveys were made of the adjoining country, and three different scales were used by different parties in order to illustrate the varying methods of work necessitated by changes in the scale of the map. Thus a nine-mile road traverse was made with sketching plane table on a scale of 1 to 30,000; a square mile of territory was mapped on a scale of 1 to 5,000, using contours ten feet apart; and a map of the mills and of the Machias river in the immediate vicinity of the town was made on a scale of 1 to 1,000.

At Howard Bay, on the sea coast, a tide gauge was set up and tidal observations were taken throughout the entire term of the school. The actual tide curves were plotted, and were compared with the computed tides given in the Coast Survey Tables.

Soundings were taken and located by sextant angles, and the soundings were plotted on a plane table survey of Howard Cove on a scale of 400 feet to an inch.

Meteorological observations were made throughout the three weeks, and were recorded in forms issued by the Weather Bureau. Practice was also given to the students in working many of the problems of practical astronomy with the sextant and engineer's transit.

The hydraulic work was essentially the same as last year, and for this reference may be made to the last annual report.

Metallurgy. — The summer school of metallurgy was this year held in the States of New York and Ohio. Visits to mines and to furnaces occur on alternate years; this was the year for furnaces. The party consisted of Professor

Hofman and seven students from the second, third, and fourth year classes of the Department of Mining Engineering, and Metallurgy. The first stop was at Syracuse, N.Y., at which point visits were made to the coke works of the Solvay Process Company, the State Union Salt Works, the Onondaga Pottery Company, the New York Paving Company, and to Church & Co., soda packers. The next stop was at Buffalo, and visits were made to the Buffalo Smelting Company, the Tonawanda Iron and Steel Company, the Buffalo Furnace Company, the Pratt & Letchworth Company, and the Atlas Works of the Standard Oil Company. The party next moved on to Niagara Falls, where they visited the works of the Carborundum Company and the Power Company. At Cleveland visits were made to the Otis Steel Company, the Cleveland Ore Docks, the Union Rolling Mill Company, the United Salt Company, the Brown Hoisting and Conveying Company, and shipyard of the Globe Iron Works. At Lorain the Johnson Company was visited. The thanks of the department and of the Institute are due to the gentlemen in charge of the above works for the kind and sympathetic interest that was taken in the students, to whom the freedom of the works was granted.

Architecture. — The Summer School in Architecture for this year was held in Quebec. Mr. Gardner, with a small party of students, spent three weeks in the town and its suburbs. It was the aim of the school to give the students practice in out-of-door sketching in pencil and water color, in preparation for a future European trip. The old town, with its historical interests, its curious people and customs, its attractive and picturesque bits of simple architecture, proved to be almost as good as a European city itself for such work.

Summer Courses.

The following volunteer courses were given to the number of students indicated. In many cases the instructors, with great self-devotion, gave their courses to a number of students too small to offer adequate remuneration, in several instances to a single student, not wishing to disappoint those who were seeking their instruction:

Programme of Summer Courses.

I. Mechanical Drawing and Descriptive Geometry. 32. (Prof. Faunce.)

II. Mathematics: Analytic Geometry. 9. (Mr. Passano.)

III. Architecture. (*a*) Shades and Shadows. (*b*) Elementary Design. 9. (Mr. Gardner.)

IV. Chemistry. (*a*) Analytical Chemistry. 27. (Dr. Walker.) (*b*) Organic Analysis, Reactions, and Preparations. (*c*) Principles of Organic Chemistry. 10. (Dr. Mulliken.) (*d*) Water Analysis, and Air Analysis. 1. (Mrs. Richards.)

V. Biology. (*a*) General Zoölogy. 2. (*b*) Bacteriology and the Micro-Organisms of Fermentation. 1. (Mr. Prescott.)

VI. Physics. (*a*) Mechanics, Light, and Electricity. 6. (Mr. Drisko.) (*b*) Heat. 7. (Prof. Clifford.) (*c*) Physical Measurements. 10. (Dr. Goodwin.) (*d*) Electrical Testing. 9. (Mr. Laws.)

VII. Modern Languages. (*a*) French. 12. (Mr. L. Bernard.) (*b*) German. 16. (Prof. Vogel.)

VIII. Mechanism. 4. (Prof. Merrill.)

IX. Shopwork. (*a*) Carpentry and Wood Turning. 8. (*b*) Chipping and Filing. 20. (*c*) Machine Toolwork. 20. (Mr. R. H. Smith.) (*d*) Forging. 7. (Mr. Lambirth.)

Summer Reading.

During the past year the Faculty, in accordance with its established policy of requiring that adequate attention be given by all Institute students to studies of a non-professional character, has voted to supplement the instruction now given in such subjects by the introduction of courses of required reading to be done in the summer vacation, following the first and the second school years.

On account of the very large portion of the student's time which in a technical school is necessarily occupied by his purely professional studies, it is difficult to introduce into the course as large an amount of instruction in literature, history, and general science as would be desirable. And it is believed that the plan of requiring summer reading in general literature is the only feasible one by which the difficulty can be overcome. In the preparation of the list of books, great care was used to select only those which are readable and attractive in character, as well as instructive, in order not to make the requirement an onerous one; for it was thought even more important to awaken interest in reading than to impart information. As far as can be judged at present, the plan has worked satisfactorily during the past summer.

Military Science and Tactics.

This service, under the care of Captain Bigelow, has made continued progress, and besides its evident educational usefulness for citizens who may be called out as soldiers, it has acquired a distinct value as an element of general culture. Unfortunately too large a share of the history of nations is the story of their military exploits, and we must recognize that some knowledge of military science which leads to a better estimate of the genius of commanders and the endurance of armies will fit a student to be a more intelligent reader of history.

In the month of April an optional course in Military Engineering was given for students of Civil Engineering. The time allowed for it was six hours, allotted to class-room work, and a half-day for field-work. Of the former, five hours were given to lectures, and one to the solution of a problem in field fortification on a map. The field-work consisted in the tracing and defilading of a line of parapet and the digging of sections of shelter trenches at the Watertown Arsenal. The attendance on this course numbered 26, which was

more than that of any former year. The success of the work in military engineering during the past two years is due in a large measure to the courtesy of Maj. J. W. Reilly, Ordnance Department, U.S. Army, commanding Watertown Arsenal, who has not only allowed the students the freedom of the grounds, but furnished them the tools for excavation, and material to be expended, and labor to assist them, in the work which they undertook.

At the commencement of the present school year the usual examination was held for the selection of officers and non-commissioned officers. The attendance and the showing made by the candidates were quite satisfactory. The attendance would doubtless have been larger but for the delusion — of which a number of the students were victims — that their previous experience in military schools or organizations would exempt them from military work at the Institute. Care will be taken to warn future students against this error.

The number of students enrolled in the regular course (Course A) is 287, and in the special course (Course B), 14. The enrolment in Course B consists mainly of students who are physically unable to drill. But in both courses students were enrolled and attended the exercises who were entitled to exemption from such exercises, but engaged of their own accord to take them. The number of voluntary students, though of necessity small, was larger than ever before.

An innovation, which is regarded by Captain Bigelow as of cardinal importance and a great improvement, is the appropriation by the Executive Committee of a fixed sum for the support of the military department, to be expended by the head of the department for the following items: care of arms; heating of armory; cleaning of armory; books, maps, slides, etc.; competitive drill, etc.; sundries.

The books acquired by the department during the past three years were placed this fall in the general library, in a rack specially provided for them. They number about 120 volumes, and, together with works of a military character in

the other libraries of the Institute, may be regarded as a good foundation, or nucleus, of a military library.

Captain Bigelow concludes his report with the following words:

"On the 1st of August, 1898, I shall have completed four years of duty at the Institute, and shall, in all probability, be relieved from such duty. I cannot close this communication without expressing my appreciation of the advantages which I have enjoyed as a member of its Faculty, and my gratitude to the professors, instructors, and students for their many kindnesses and uniform courtesy and consideration. I know that I have taken from the Institute more than I have given it, but I shall always be willing to balance the account by any means at my command, and shall ever esteem my four years' tour at the Institute as one of the pleasantest and most profitable periods of my career."

Courses I. and XI., Civil and Sanitary Engineering. — Some changes have been made in the work of the fourth year, in consequence of the transfer to the third year of the course in applied mechanics.

The changes in Course I. consist in introducing in the first term a course in industrial electricity; in increasing the preparation allowed in the course in astronomy; in adding in the second term a special course in foundations (a subject previously included in the course in structures), and in extending throughout the entire term the course in machinery and motors, previously given in the last term only. The course in Civil Engineering now comprises, besides the usual courses in purely civil engineering subjects, a not inconsiderable amount of instruction in mechanical engineering; namely, the course in mechanism in the second year and the course in steam engineering which extends throughout the fourth year.

In Course XI. the changes made consist in introducing the courses in metallurgy of iron and industrial electricity, together with a short course of thirty hours in shop work, especially devoted to pipe-fitting. This course will be

especially useful to those who desire to become sanitary inspectors.

The Geodetic Laboratory, for which an appropriation was made last year, and to which reference was made in the last annual report, has not yet been erected, for the reason that upon working out the detail plans and specifications and getting bids for the work, the appropriation proved too small. An increased appropriation having been made for the present year, a location has been selected in the Middlesex Fells and permission obtained from the Metropolitan Park Commissioners for the erection of the building. It is expected that it will be ready for use early in the spring.

Mention should here be made of the publication in the Technology Quarterly of the results of Professor Burton's expedition to Greenland last year. The report of Mr. Putnam, of the U.S. Coast and Geodetic Survey, giving the results of the pendulum and magnetic measurements, constitutes an especially interesting memoir, and one whose scientific value has been shown by expressions of approval from the highest sources.

The equipment of the department has been somewhat increased during the past year. A powerful rotary pump with a capacity of 1,000 gallons per minute has been added in place of a smaller one which was worn out. A Milton Smoke Tester for testing the tightness of house drains has been purchased, together with various smaller pieces of apparatus. Emphasis should here be laid on the need of an enlargement of the reservoir used in connection with the hydraulic plant, to which reference was made in the last report. Mention may also be made of some thesis work on the loss of head attending sudden contractions in area of pipes, completing a series of experiments in this direction which have been taken up in several successive years.

Excursions have been made to Worcester, Brockton, and Moon Island, and thanks are due to President Lucius Tuttle, of the Boston & Maine Railroad; General Manager W. H. Barnes, of the Boston & Albany Railroad; Mr. F. H. Snow,

City Engineer of Brockton, and Mr. B. W. Wells, Superintendent of Streets of the City of Boston, for courtesies extended in connection with these excursions and with the general work of the course. In connection with the work in hydraulics, a lecture was given by Mr. A. V. Garratt, Chief Engineer of the Lombard Water Wheel Governor Company, on governing devices for turbines.

There is pressing demand for more room in order to carry on to the best advantage the work in civil engineering. The second and third year drawing-rooms are crowded beyond their reasonable capacity. In the second year drawing-room there are 96 students, while the greatest number which we have ever had before has been 66. It is imperative that additional space should be provided, unless the number of students in these courses is restricted. In the third year drawing-room there are 56 students. In the fourth year, there are 38 students, of whom three are in Course XI., and one takes but few studies in this year. Of the remaining 34, 20 have chosen the first or general option, and 14 the second or railroad option.

Course II., Mechanical Engineering. — Attention was called in the report of last year to the improvements in the third year work of the course consequent upon the advance of entrance requirements. Time has now been gained in the fourth year by the omission of the lectures on dynamo machinery heretofore given by Professor Cross, consequent upon the introduction among the third-year studies of the courses in industrial electricity and dynamo-electric measuring instruments and methods; and also by the transfer of Political Economy from the fourth to the third year. In consequence of the above changes, and of some other readjustments of studies, the following new or enlarged courses have been introduced:

1. SHOP MANAGEMENT. — Professor Schwamb will give a course of ten exercises on this subject in the second term of the fourth year, each exercise requiring two hours' preparation on the part of the student.

2. A course on Foundations will be given to the fourth-year students by Professor Lanza.

3. The time heretofore taken from the options for the lectures on industrial management and dynamo machinery being restored, the work of all three of the options will be correspondingly extended and improved.

4. The course in machine design has been increased by fifteen hours.

THE ENGINEERING LABORATORIES. — The number of students having assignments to regular laboratory exercises in the portions of the engineering laboratories other than the laboratory of applied mechanics was, during the school year '96–97, 239. The nature of the tests, and the number of each kind performed in the regular laboratory work, has been as follows, viz.:

Tests of the transmission of power by belting	44
Tests of the flow of steam through orifices	76
Tests of the triple expansion engine where the heat balance is made	4
Ordinary tests of the triple engine	60
Test of steam-boiler plant, 72 hours long	1
Tests of surface condensers	72
Tests of steam injectors	70
Tests of steam ejectors	70
Tests of steam pumps	52
Calorimeter tests of steam	65
Tests of 36 H.P. gas engine	70
Valve setting of plain slide valve	76
Valve setting of Meyer valve	50
Valve setting of Corliss valve	68
Tests of pulsometer	76
Tests of Pelton water wheel	84
Tests of Swain turbine	66
Tests of rotary pumps	74
Tests of hose nozzles	72
Tests of plunger pumps	76
Tests of pulley blocks	44
Tests of gauges	44
Tests of jackscrews	28
Tests of hot-air engines	76
Tests of planimeters	26
Tests of hydraulic ram	19
Total number of tests in regular work of engineering laboratories other than laboratory of applied mechanics	1,463

It may be well to add that the results of the tests are computed by the students performing them, and examined by some of the instructing staff who have previously made the computations themselves.

The difference between the old practice in mechanical engineering and the more scientific training of the modern school is the difference between guessing and testing. The guess often led to an unpleasant surprise in coal consumption at the end of the year, and the loose kind of accounting which makes manufacturing enterprises uncertain. The demand of the present day is for engineers capable of testing accurately each part in the performance of a machine.

APPLIED MECHANICS. — The number of students having assignments to regular work in the laboratory of applied mechanics in '96–97 was 182.

The nature of the tests performed, and their numbers, were as follows, viz.:

Tests of bolted joints in steel plate	8
Tests of wrought-iron pipe columns	20
Tests of crushing strength of cast-iron water-pipe from 6 in. to 48 in. in diameter	31
Tests of timber beams	44
Tests of tensile strength and elasticity of Burden-iron 2 in. in diameter	33
Tests of tensile strength and elasticity of refined iron 1 in. in diameter	16
Tests of torsional strength of compositions	12
Tests of tensile and torsional strength and elasticity of wire of wrought-iron, of steel, and of brass	174
Tests of the tensile strength of various knots and hitches in manila and hemp rope, and of the rope itself	70
Tests of tensile strength of cement and mortar	100
Tests of compressive strength of cement and mortar	100
Miscellaneous tests of iron and steel	27
Other miscellaneous tests	105
Total number of tests made in '96–97 in the regular work of the laboratory of applied mechanics	740

Since the publication of the last president's report there have been issued Nos. VI. and VII. of the "Results of Tests

made in the Engineering Laboratories," No. VI. being a reprint from the Technology Quarterly, Vol. IX., No. 4, December, 1896, and No. VII. a reprint from Vol. X., No. 3, September, 1897, the former containing the results of a number of the tests in steam and hydraulics, including a test of the plant at the Charlestown power-station of the West End Street Railway; together with several steam-boiler tests, and the latter containing the results of tests of timber trusses and headers, together with half-tones of the fractures; and also results of the tests of cast-iron water-pipe.

While the apparatus added to the engineering laboratories a year ago has proved very useful, it should be observed that the increasing demands upon these laboratories, the large amount of thesis work for which the apparatus has to be used, together with the need of constant extension to keep in touch with the outside development of practical engineering work, render it important that we should have additional apparatus. For this additional room is a necessity.

Course III., Mining and Metallurgy. — The second, third, and fourth year classes number respectively 23, 8, and 7. It has been mentioned that Mr. Howe, who has for many years been Lecturer in Metallurgy for our fourth-year students, has left us. We are fortunate in being able to commit this subject to the able teaching of Professor Hofman. In view of the increased work of the department, a new Assistant has been appointed by the Corporation.

The laboratories have been extended and the work made more efficient. The assay laboratory has been enlarged by the addition of twenty-six new desks; five new pulp-balances and four new button-balances have been added. The supply-room has been nearly doubled in storage capacity. In the ore-dressing room the rolls, the Hendy feeder, the centrifugal pumps, and the dust-fan have been thoroughly renovated and connected anew to the power so as to give them greatly increased efficiency. Of new machines that have been purchased or ordered, there may be mentioned a new Woodbury

belt vanner, a Sturtevant roll-jaw crusher, a Harz jig, and a canvas table. Other machines will be added in the near future.

Basing the estimate on the numbers that are now taking the desirable course in the first and second years, the present laboratories and instructing force are not large enough to meet the needs of the immediate future. It would seem that the whole basement of Rogers Building, or some equivalent space, should be placed at the disposal of the department.

The library has grown to such an extent that a new bookcase has been added and the whole library rearranged. Two important periodicals have had their files made up so that they are now complete from the first numbers to date; they are the "Freiberger Jahrbuch" and the "Revue Universelle des Mines." A complete set of Karsten's Archiv has been purchased. Three new periodicals have been added; namely, the "Iron Trade Review," the "South African Mining Journal," and the "Journal of the American Foundrymen's Association." Arrangements are being made for obtaining the Proceedings of two engineering societies in South Africa, and of six in Great Britain.

Professor Richards is still engaged upon the preparation of his book upon Ore Dressing, which will soon be ready for the press.

Professor Hofman's revised and enlarged edition of his work on the Metallurgy of Lead is now in press.

Professor Richards, with the aid of Mr. C. E. Locke, has prepared a paper on the Spitzkasten, which was read before the American Institute of Mining Engineers.

Professors Richards and Hofman have each contributed articles to "The Mineral Industry," the former on the Progress in Ore Dressing in 1896, the latter on Recent Improvements in Lead Smelting.

Course IV., Architecture. — During the past year there have been few changes made in the work of the Architectural

Department, but in several respects it has been greatly strengthened. Full-sized models of the Doric and Ionic orders from the theatre of Marcellus, made during the summer from the most accurate drawings obtainable, have been placed in the drawing-room of the second-year students. The shafts are omitted, for lack of height, but anticipating the time when the museum is certain to become an indispensable part of our plan, the models have been so constructed that they can be easily completed. They will then offer an opportunity for study which can only be surpassed in Rome itself. These models serve as our text-books, and are sketched, measured, and drawn out, giving a far better knowledge of scale and construction than can possibly be learned in any other way. It is needless to say that this instruction is carried on with much greater interest to the students. We have only two large models as yet, for we cannot afford to infringe on the area of the drawing-room; but the scheme should be carried to its completion as soon as possible, if the best results are to be obtained.

In Architectural History great improvement has been noticed in the interest and work of the students, due to the increased number of lectures and the concentration of the course in the second and third years. This change in the course scheme has given opportunity for the introduction of the study of the history of painting and sculpture, which has heretofore been carried on in a less systematic manner, whenever we have been able to procure a lecturer on these subjects. A course is now regularly established, in charge of Professor Sumner. It is certain to prove of much value and interest.

This year we have nine students engaged in graduate work. The value of this extra year becomes continually better appreciated, as is shown by the steady increase in numbers from year to year.

The students of the Institute, for the fifth time in succession, won both the competitions of the Beaux Arts Society

of Architects of New York, and, as before, bore off the gold medal and the highest honors.

The two Rotch Scholarships, each amounting to about two hundred dollars, were awarded this year to Mr. T. E. Videto, of South Framingham, and Mr. H. M. Seaver, of West Roxbury. Mr. Videto has returned this year as a candidate for an advanced degree.

The Boston Society of Architects also generously continued its two prizes of the value of fifty dollars each in books. A beautiful edition of Piranesi, the gift of Mrs. Henry Draper, has been added to the library, while Prof. W. R. Ware, of Columbia University, has presented two valuable lithographs, restorations, by Viollet-le-Duc, of a Doric Temple and the Baths of Caracalla.

Mr. Cass Gilbert, of Minneapolis, has most generously presented to the department a set of blue prints of the Brazer Building, in Boston, of which he was the architect, with his written description. Many novel conditions occurred in the planning of this building, and his methods of solving them are exceedingly interesting.

Mr. James M. Hubbard has also presented to the library three volumes of the Palestine Exploration Fund.

The department becomes more hampered each year for want of space and the proper adaptation of it to the present demands of architectural education. The museum is badly needed. The library has become entirely inadequate to allow of the proper care, use, or display of its exceedingly valuable collections. The drawing-rooms are crowded this year to their utmost capacity. The condition of things can be understood from the fact that we have twenty-two more students in the department than last year.

Courses V. and X., Chemistry and Chemical Engineering. — The President has retained the general direction of the Chemical Department and given the lectures upon organic chemistry, but it is hoped that during the coming year a new professorial appointment may be made. Thanks to the great zeal and

activity of the professors and instructing staff, the usual routine of work has been carried on satisfactorily.

The removal to the State House of the service of water analysis for the State Board of Health has permitted a rearrangement during the summer of the Rooms 36 and 38 of the Walker Building. The former is now devoted entirely to sanitary chemistry and to proximate analysis, and proves hardly sufficient for those purposes, not to speak of a rapidly increasing demand. A new laboratory course in proximate technical analysis has been introduced in place of the option in sanitary chemistry for the fourth-year students. This course, which has been in charge of Dr. Whitney, comprises the examination of a number of industrial products, such as asphalt, rubber, paper, soap, tannin, and fertilizers. Each student is required to look up the processes to be employed, and to present reports on his work before the class, so that an acquaintance with the literature of the several subjects is acquired by the class, and original thought is encouraged and developed. It is believed, moreover, that some practice in this line of work will prove of direct practical value to our chemists. The option has been chosen by a large number of the present fourth-year class. The investigation of the action of soft water upon boilers will be continued throughout the year, as well as that upon the ventilation of public buildings, and, among others, further studies in the purification of water and sewage will be carried out. Dr. Gill now occupies Room 38. The space used for oil and gas analysis has been divided into a small lecture and study room (seating twelve students) and a laboratory. The latter has desks for thirty-six students, accommodating fifteen at one time, and serves during the first term for oil analysis and the second term as a research laboratory for the students in chemical engineering.

The notes in oil analysis have been published under the title "A Short Handbook of Oil Analysis." They enable the instruction to be given much more thoroughly and systematically than before.

The equipment of the gas laboratory has been materially increased by the addition of a Junker calorimeter for determining the heating power of gases.

No important changes have been made during the year in the teaching of general Chemistry. The class numbers 380.

ANALYTICAL CHEMISTRY. — The students taking Analytical Chemistry number 119 in all; they are distributed as follows:

	Second year.	Third year.	Fourth year.
Mining Engineering	2	16	9
Chemistry	29	29	
Biology	4	2	
Physics	2		
Chemical Engineering	12	1	2
Sanitary Engineering		3	
Miscellaneous	8		
Total	57	51	11

This year, for the first time, it was necessary to refuse admission at the opening of the term to a few students whom we should otherwise have been ready to receive, because it was impossible to give them desk-room. Some of these have since been allowed to enter the laboratory, taking the place of students who have, for various causes, dropped the subject; but others could not be admitted at all. It is, of course, too early to state definitely the conditions which will prevail next year, but if the number of students entering the various courses remains the same as for the past two years, it seems improbable that we should be able to accommodate all who are rightfully entitled to desks in the laboratory but for the additional space gained by the erection of the new building. The unusually large number of students entering the Course in Mining Engineering last year (about 30), who will take analytical chemistry for the first time next year, will make a new demand upon our desk-room.

The equipment and instructing force remains unchanged, and the general scheme of instruction has only been modified in some minor details.

ORGANIC CHEMISTRY. — The additional places provided last year have been filled. Thirty students now take Organic Chemistry. The work in the laboratory has been facilitated by the new arrangements. No changes have been made in the instructing staff. The titles of researches on a following page give evidence of the activity of the instructing staff, and show that the students in their last year are brought in contact with teachers who are themselves doing the kind of original work which is the best training for a practical chemist.

Under the charge of Mr. Rolfe twenty-six students have been instructed in sugar analysis, with the use of the most approved model of polariscopic apparatus, and two students, Messrs. Faxon and Hemmings, have used these instruments in original investigations, under Mr. Rolfe's direction.

The class in Industrial Chemistry has increased from thirty-seven to fifty-two. The lectures delivered by Dr. Thorp have been supplemented as usual by outside lectures from chemists in charge of important manufacturing works in the neighborhood of Boston. A lecture on the manufacture of glue and gelatine by Mr. George R. Underwood, of the Upton Glue Works, has this year been added to the list.

Visits were made by the class last year to the following manufactories:

Merrimac Chemical Works, South Wilmington, Mr. A. P. Howard, superintendent.

Curtis Davis Soap Works, Cambridgeport, Mr. E. D. Mellen, manager.

Union Glass Works, Cambridgeport, Mr. J. de Cordova, president.

Malden and Melrose Gas Works, Malden, Mr. T. H. Hintze, superintendent.

The Tileston and Hollingsworth Paper Company, Mattapan, Mr. A. L. Hollingsworth, treasurer, Mr. Mossman, superintendent.

Publications of the Chemical Department.

1897.

Theoretical Chemistry.

W. R. Whitney: (1.) The Dilatometric Measurement of the Velocity of the Hydrolysis of Cane Sugar.

(2.) An Electrical Thermostat.

(3.) With A. A. Noyes: The Rate of Solution of Solid Substances in their own Solution.

A. A. Noyes: Bemerkung über die kinetische Theorie der Lösungen.

A. A. Noyes and R. S. Wason: The Velocity of the Reaction between Ferrous Chloride, Potassium Chlorate, and Hydrochloric Acid.

A. A. Noyes and C. G. Abbot: (1.) Bestimmung des osmotischen Druckes mittelst Dampfdruckmessungen.

(2.) On the Relation between the Osmotic Pressure and the Vapor Pressure of Solutions.

A. A. Noyes and W. R. Whitney: Ueber die Auflösungsgeschwindigkeit von festen Stoffen in ihren eigenen Lösungen.

Analytical Chemistry.

A. A. Noyes: A Detailed Course of Qualitative Chemical Analysis. Third edition.

A. H. Gill: A Shorthand Book of Oil Analysis.

A. A. Noyes: Synthesis of Hexamthylene-Glycol Diethyl Ether and other Ethers from Trimethylene Glycol.

A. A. Noyes and S. P. Mulliken: Laboratory Experiments on the Class Reactions and Identification of Organic Substances. Second edition.

J. F. Norris: Action of the Halogens on the Aliphatic Amines and the Preparation of Perhalides from Them.

Sanitary Chemistry.

E. H. Richards:

(1.) Domestic Science, What it Is and How to study It.
(2.) Foods and Diet, Comparative Value.
(3.) A New Color Standard for Use in Water Analysis.
(4.) Notes on the Evidences of Dissociation in Dilute Soap Solutions.

Courses VI. and VIII., Electrical Engineering and Physics. — In these as in other courses the effects of the increased entrance requirements in mathematics have been advantageously felt during the past year, and will be still more evident during the present year, when they will affect the whole four years of the course. In the scheme for the fourth year of the Course in Electrical Engineering the time gained allows of a very large additional amount of practice in the study and testing of dynamo-electric machinery in the laboratory of electrical engineering — a need which has been strongly felt by the department for several years past, on account of the rapid introduction of entirely novel forms of such machinery. It has also been possible to make some extension in the time given to general electrical measurements and testing.

In part for the same reason, and in part because of the general advance in the level of the instruction in the third year, it has become possible in the fourth year to devote a larger number of exercises than hitherto to the principles of the design of dynamo-electric machinery. The course of instruction in designing dynamos was assigned last year to Mr. Louis Derr, Instructor in Physics. The results were highly satisfactory, and Mr. Derr will take charge of the enlarged course to be given this year. Thus the constant supervision of an instructor has replaced outside professional services. His work will be supplemented by a brief course of lectures by Mr. John B. Blood, M.I.T., '90, who has had large experience in dynamo design in connection with the General Electric Company.

In the Course in Physics (VIII.) there has been considerable readjustment of studies. The subject of the theory and methods of telegraphy, hitherto taken in connection with Course VI., was quite technical, and it has therefore been removed from Course VIII. and replaced by a course in photometry by Professor Clifford, transferred from the fourth year and at the same time extended. A brief course upon the kinetic theory of gases by Professor Goodwin will be inserted in the fourth year.

Other important changes allow the option of the simultaneous study of analytical chemistry and advanced mathematics in the third year, first term; and the requirement of Fourier's Series throughout the fourth year, of all candidates for a degree, the study of analytical mechanics in the fourth year becoming an option, with organic chemistry as an alternative. This arrangement has been desired for some time, but for certain reasons has not hitherto been possible.

It should also be mentioned that the instruction in general Physical Measurement has been materially extended for the students in the Course in Chemistry. Also it has been found possible to begin this work at the middle of the second year instead of a term later, so that this is now the case with the Courses in Chemistry, Physics, Electrical Engineering, and General Studies. This earlier start in accurate physical measurement is very desirable for several reasons. The work in the laboratory is thereby brought into closer relation to the lectures, the students pursuing it are less distracted by purely professional work, and the time in the later years is open for more advanced physical work when desired.

As in previous years the course has been much extended by the aid of the profession. During the past year, courses of lectures have been given by Mr. George W. Blodgett, Electrician of the Boston & Albany Railroad, on the Application of Electricity to Railway Signalling; Mr. Hammond V. Hayes, Electrical Engineer of the American Bell Telephone Company, on Telephone Engineering; Mr. Louis Bell, on the Electrical

Transmission of Power and the Application of Electricity to Railway Transportation; Mr. Hollis French, on Electrical Engineering Practice and Specifications; Mr. Howard C. Forbes, on the Design and Testing of Electric Light and Power Plants; Mr. Odin B. Roberts, on the Nature and Function of Patents for Inventions; and single lectures have been given by Mr. C. J. H. Woodbury, of the American Bell Telephone Company, on Electricity in its Relation to Fire Risks; Mr. Ernest A. LeSueur, on the Industrial Applications of Electro-Chemistry; Mr. S. Everett Doane, of the General Electric Company, on the Manufacture of Incandescent Lamps; and Professor Elihu Thomson, on Recent Lines of Development in Applied Electricity.

The equipment of the department has been greatly augmented during the last year. Especially noteworthy is the separate plant of combined dynamo-machines and steam-engine for testing, referred to in the President's report of last year as in process of erection. This is proving of the utmost advantage, not only in the work of the Course in Electrical Engineering, but to students of Mechanical Engineering as well. The installation is satisfactory in all respects. Some fear had been felt lest the room immediately above should be rendered noisy, but so smoothly does the machinery run that its action is not noticed.

Various important pieces of physical apparatus have also been added. Of these there should be particularly mentioned a cathetometer, with two telescopes, manufactured by the "Société Genevoise." This magnificent instrument was purchased from the fund bequeathed to the Institute by Mrs. Katharine Bigelow Lowell, and appropriated by the Executive Committee to the purchase of physical instruments. The cathetometer bears an inscription to this effect.

The increased interest which the discovery of the Röntgen rays has excited in the general subject of the passage of electricity through high vacua has led us to enlarge our collection of apparatus illustrative of this branch of physics, so

that it is probably unexcelled in this country. Various new vacuum tubes of our own devising have been added to it.

Through the kindness of Mr. George W. Blodgett the department has received the loan of a complete set of quadruplex telegraphic instruments, which has proved most useful in illustrating the lectures on that subject. We are also, as in previous years, greatly indebted to the American Bell Telephone Company for the use of much valuable apparatus.

The work of the laboratory of electrical testing is greatly facilitated by the new method employed for the support of the sensitive galvanometers. The Julius suspension, adopted by Professor Laws after a tentative trial of some months, has been found very satisfactory. The jarring of even the heaviest vehicles is without very serious effect, and ordinary disturbances of this kind are scarcely noticed.

The equipment of the laboratory of heat measurements has been increased by the construction, under the direction of Mr. C. L. Norton, of a comparator for thermometers, which, added to what we already possessed, renders our apparatus for comparing and examining standard thermometers exceedingly complete. The construction of two new coal calorimeters, one of the type of the Berthelot bomb, the other a simple and more easily manipulated form of calorimeter, permits of more complete examination of the efficiency of fuels than has hitherto been possible anywhere. The laboratory has further acquired a Heraeus thermo-electric pyrometer for measuring melting points, furnace and flue temperatures, and general technical work in heat measurements.

Regarding the difficulties under which the department labors on account of lack of room, there is nothing to be said beyond what was stated in the President's report of last year. The pressure has not diminished, but, realizing the impossibility of immediate remedy, the instructing force has used its best endeavors to so distribute the work as to relieve the

congestion as far as possible. This has often necessitated a frequent repetition of exercises, with corresponding draught on the time and strength of the instructors. In the laboratories of heat measurements and physical chemistry the crowding has been most extreme, but the work of this character has been satisfactorily, though not easily, carried through as laid out in the programme. But it has not yet been possible to extend it as might be done under more propitious circumstances as to accommodations.

Course VII., Biology. — Professor Sedgwick reports that the more elementary class-work is efficient and satisfactory, but states that the opportunities for advanced work and investigation are totally inadequate. He urges that provision be made at the earliest possible moment for a considerable increase in laboratory accommodations, especially for research, in his department. To show how pressing this need is he further states that an important and eminently practical investigation, which he has long had in view, upon the microscope structure of the various textile fibres, particularly hemp and sisal, is now ready to be set on foot as soon as space can be found in which to carry on the work. Room is also urgently required for experiments on the effect of certain processes in dyeing, upon the microscopic structure of the fibres treated; for further investigations upon milk and water; for experiments affecting the arts of canning and food preserving, as well as for certain special researches in pure bacteriology.

The notable growth of the work of this department along practical sanitary and industrial lines, which was dwelt upon at some length in the last report of the President, continues and is bearing fruit. Nowhere in America, perhaps, are the fundamental principles of sanitation and their application to the great public supplies — water, milk, and gas — more carefully considered or more intelligently taught. This is important not only to the public welfare of the community at large, but also to those of our own graduates who as chem-

ists, engineers, or architects are liable to be brought unexpectedly face to face with sanitary problems. A large part of the civic or municipal engineering of the day is based upon the modern requirements of sanitation, and the Institute is fortunate in being able through its biological department to present adequately, yet concisely, to its students in other departments the fundamental facts, theories, and practice of sanitary science.

The new course in Industrial Biology begun last year has proved eminently successful, and credit in this connection is due to Mr. S. C. Prescott, Instructor in Biology, who, under the direction of Professor Sedgwick, has given largely of his time and thought to its development. The rapid growth of discovery in this direction makes it likely that more time will soon have to be given to the subject. The contributions to our knowledge of micro-organisms and sterilizing processes in the canning industry, begun last year by Messrs. Prescott and Underwood, have since been repeated in part by the Canadian Government, with confirmatory results. A preliminary account of the more recent researches of Messrs. Prescott and Underwood (upon the efficiency of the processes employed in the canning of sweet corn) had just been issued from our laboratory.

All these and similar contributions to applied biology, however, in the last analysis, rest upon the sure foundation of pure science; and it is therefore gratifying to note that the work in comparative physiology, under Assistant Professor Hough; in comparative anatomy and zoölogy, under Dr. Weysse; and in botany, under Mr. Prescott, continues to be of high efficiency. Assistant Professor Hough has published during the year an important paper on the physiology of inhibition. A valuable series of lectures by Dr. Bigelow, on theoretical biology, of which he has recently published a syllabus, is also worthy of mention.

Through the continued kindness of Mrs. William B. Rogers this department was again presented during the last year, as

has been the case for several years, with two annual scholarships in the Marine Biological Laboratory at Wood's Hole. These were held with great advantage by Messrs. C.-E. A. Winslow, of the fourth year, and C. W. Perley, a recent graduate of the department.

It is hoped that the project, described at length in the last report, can be carried out this year; and that the natural development of this department will no longer suffer from want of space for research laboratories. The thesis work of the fourth-year students and the original work of instructors and graduates or special students are most fruitful sources of scientific inspiration, and contribute essentially to maintain the enthusiastic feeling which marks the growth of a department. Increased accommodations are also called for on the ground of the public usefulness of biological experiments.

Course IX., General Studies. — English, History, Economics. — Professor Bates has now in operation the plan arranged in conjunction with President Walker for the oversight of the English of students above the first-year grade. It is a singular fact that men who do good work in first-year composition seem to regard the need of care in writing as entirely done when they have once passed their examinations. Men whose first-term themes are really excellent sometimes fall into slovenly and incorrect habits of expression, so that their later written work is inexcusably bad. These students are now looked after, and are kept reminded of the fact that they are expected to live up to the standard which enabled them to pass in the first place.

The work in composition in the first year is also improved. The addition of an assistant to the staff of the department allows an increase of thoroughness, and makes possible a much greater amount of personal consultation.

An important gain has been made in adding advanced composition, formerly an option in the fourth year, to the required third-year studies of the Course. This has the advantage of giving to the students in the course a more

complete training in composition; it has also made room for the introduction of a course in argumentation as an option in the fourth year. Coming in the first half of the year, this course is an excellent preparation for thesis work.

The work in Literature has not undergone much change during the year, except that in the second year the course has been to some extent modified in connection with the required summer reading. There is in the fourth year of the Course an increase of written work in connection with eighteenth and nineteenth century literature.

In Economics there has been but little change. The department, however, has been called upon to give a course to the fourth-year students in Electrical Engineering, on Economics of Corporations. The more detailed studies of Dr. Ripley on the Racial Geography of Europe, delivered last spring in the Lowell course, are now being published in the "Popular Science Monthly." Prof. Dewey has been appointed to serve as a member of the Boston Department of Municipal Statistics.

Course XII., Geology. — During the year several quite material changes in the succession of studies have been necessitated by the desire to modify certain courses in other departments. There have been but two options in the Course in Geology, and those were confined to the first term of the fourth year, but in the present schedule two options are offered in the second year and three in the succeeding years. By this arrangement students may devote certain portions of their time to an increased amount of either chemistry, comparative anatomy, or surveying.

Mr. M. L. Fuller, a graduate of the Institute of '96, who was last year engaged upon the Geological Survey of Michigan, is now an Assistant in this department.

There have been important additions to the collections and appliances for teaching. A most valuable accession has been made of a good series of large physical and geological wall-maps.

A large number of the Reports and Atlases of the Geological Survey of Pennsylvania, by Henry D. Rogers, have been given to the department by Mrs. H. D. Rogers and Miss Mary Otis Rogers, for distribution among other institutions. Correspondence has been conducted with fifty colleges and universities, and sets of the volumes have been furnished to thirty-six of them. The correspondence, the selection and transmission of these, has required a large amount of work, but it has promoted our friendly relations with other institutions.

Course XIII., Naval Architecture. — Few changes have been made in this Course since its commencement. The students are now given the accepted theory of their profession, mainly from notes especially arranged to conform to the methods of instruction of the school, and to use to best advantage the knowledge acquired in the engineering courses.

The preparation of such notes and the work of instruction in this subject are greatly facilitated by the sound training of the students in physics, applied mechanics, and steam engineering, which allows of a brief and comprehensive statement of many subjects which are ordinarily treated at length in works on shipbuilding and naval architecture.

Mr. Swan, who has returned after a year's study on leave of absence abroad, is now using his experience there to improve and extend the instruction given by him in drawing, ship calculations, ship construction, and design.

It is hoped that the new building will afford space for a drawing-room with large tables specially adapted to the requirements of naval designing. The need is greatly felt in this department of a room for storing safely and arranging for use drawing instruments and models such as those which have served for important work in the study of resistance and stability.

Last winter a set of progressive speed trials was made on the police boat "Guardian," by permission of the Board of Police Commissioners, over a well-defined course in the

harbor. The analysis and discussion of the results of these trials formed the subject-matter of the thesis presented at graduation by one of the class that was graduated last June, and have since been embodied in a paper presented to the American Society of Naval Architects and Marine Engineers.

Instruction was given in mould-loft work at the Navy Yard, as has been done for several years, through the courtesy of the Secretary of the Navy and of officers in the Navy Department. It is hoped that this valuable work may form a fixed feature of the Course.

Mathematics. — The work of the department has been conducted during the year without essential change. The advance in 1895 in entrance requirements has now reached its full effect, however, in the transference from the fourth year to the third year of the course in differential equations.

The department library is now provided with the more important periodicals, and with an adequate collection of models. An increase in the supply of important works of reference is, however, much desired. All the elective courses have been taken during the year, and a more advanced course in elliptic functions is now conducted by Professor Woods.

Modern Languages. — The department necessarily depends immediately upon the standard of the entrance requirements for the extent to which its teaching can be developed, so that no important change is to be expected until further advance is made in the preparation of the entrance class. So far as the modern languages are destined to be used to afford free access to foreign text-books, such as is frequently required in many professional studies, the excellence of our teaching is continually put to the test with satisfactory results. It is found in the different departments that the students in their third and fourth years read French and German sufficiently well for the consultation of text-books.

Professor van Daell recommends that uniformity in the teaching of the different sections shall be secured by the employment at frequent periods of written tests identical in all

sections. The use of a part of the time of an assistant would be required for the examination of papers.

There have been no considerable accessions to the library. The allowance for the purchase of books is used chiefly for the most useful books of reference.

STATISTICS OF CLASSES.

THE ENTERING CLASS.

The registration of this year, as by the Catalogue now in press, amounts to 1,198, exactly the same as twelve months ago.

YEAR.	No. of Students.	YEAR.	No. of Students.
1865–66	72	1882–83	368
1866–67	137	1883–84	443
1867–68	167	1884–85	579
1868–69	172	1885–86	609
1869–70	206	1886–87	637
1870–71	224	1887–88	720
1871–72	261	1888–89	827
1872–73	348	1889–90	909
1873–74	276	1890–91	937
1874–75	248	1891–92	1,011
1875–76	255	1892–93	1,060
1876–77	215	1893–94	1,157
1877–78	194	1894–95	1,183
1878–79	188	1895–96	1,187
1879–80	203	1896–97	1,198
1880–81	253	1897–98	1,198
1881–82	302		

STUDENTS BY CLASSES.

The aggregate number of students for 1897–98 is divided among the several classes as follows:

Graduate student, candidates for advanced degrees	9
Regular students, Fourth Year	203
" " Third "	178
" " Second "	197
" " First "	279
Special students	332
Total	1,198

Assigning the special students to classes, according to the predominant studies pursued by them, we reach the following division of the whole body among the several years:

Class.	Regular.	Special.	Total.
Graduates of the M.I.T.	9		9
Fourth Year	203	72	275
Third Year	178	91	269
Second Year	197	130	327
First Year	279	39	318
Total	866	332	1,198

Statistics of Examinations.

Of the 1,198 students of the present year, 441 were not connected with the school in 1896–97. Of these, 259 were admitted as regular students of the first year upon the basis of their entrance examinations. The 182 remaining comprise (1) those who had previously been connected with the Institute, and have resumed their places in the school; (2) those who were admitted provisionally without examination; (3) those who were admitted by examination as special students; (4) those who were admitted on the presentation of diplomas or certificates from other institutions of college grade. In addition to the 259 who were thus admitted to the Institute on examination, and have taken their place in the school, 91 were admitted on examination, but have not entered the school. The number of this last class, always large, has this year been increased even over that of last year by the continued depression in business.

In the case of the 259 persons who were admitted on examination, and have joined the school, the results of the examinations, embracing both those of June and those of September, were as follows:

Admitted clear	192
" on one condition	34
" on two conditions	23
" on more than two conditions	10
	259

Fifty applicants were rejected.

Examinations at Distant Points.

In addition to the entrance examinations held at Boston in July and September, examinations were conducted in July at Belmont (Cal.), Buffalo, Chicago, Cincinnati, Cleveland, Denver, Detroit, Easthampton (Mass.), Exeter (N.H.), Indianapolis, Kingston (Pa.), Lawrenceville (N.J.), Lead (So. Dak.), Louisville, New York, Philadelphia, Pittsburgh, Portland (Me.), Pottstown (Pa.), Poughkeepsie, Southborough (Mass.), St. Paul, Utica (N.Y.), Washington.

RESIDENCE OF STUDENTS.

STATES.	Candidates for Advanced Degrees.	Fourth Year.	Third Year.	Second Year.	First Year.	All Regular Students.	Special Students.	Total.
Alabama	..	..	..	..	..	..	1	1
Arkansas	..	..	..	..	1	1	..	1
California	..	1	1	3	1	6	3	9
Colorado	..	1	3	..	2	6	2	8
Connecticut	..	7	3	2	14	26	4	30
Delaware	1	1	1	..	1	4	2	6
Dist. of Columbia	..	1	3	..	3	7	6	13
Florida	..	..	..	..	1	1	..	1
Georgia	..	1	1	1	..	3	1	4
Idaho	..	..	1	..	..	1	..	1
Illinois	1	5	7	12	4	29	11	40
Indiana	..	..	1	1	2	4	3	7
Iowa	..	1	4	2	1	8	4	12
Kansas	..	2	..	..	..	2	1	3
Kentucky	..	2	3	1	2	8	2	10
Louisiana	..	..	..	..	1	1	..	1
Maine	..	6	4	6	3	19	5	24
Maryland	..	1	2	..	2	5	3	8
Massachusetts	7	133	102	133	176	551	188	739
Michigan	..	1	2	1	1	5	..	5
Minnesota	..	..	1	..	4	5	3	8
Missouri	..	..	2	1	1	4	2	6
Montana	..	1	..	..	3	4	1	5
Nebraska	..	1	..	..	..	1	1	2
New Hampshire	..	5	3	5	5	18	7	25
New Jersey	..	4	2	1	2	9	6	15
New York	..	12	5	8	15	40	22	62
North Carolina	..	..	..	1	..	1	..	1
Ohio	..	4	2	4	10	20	10	30
Oregon	..	1	..	..	..	1	2	3
Pennsylvania	..	5	5	6	10	26	15	41
Rhode Island	..	3	5	2	3	13	6	19
South Carolina	..	..	..	1	1	2	2	4
Tennessee	..	1	1	..	1	3	..	3
Texas	..	1	..	..	..	1	1	2
Utah	..	..	2	..	..	2	1	3
Vermont	..	..	2	3	2	7	4	11
Virginia	..	1	2	..	..	3	1	4
Washington	..	..	..	1	1	2	2	4
West Virginia	..	..	..	..	..	..	1	1
Wisconsin	..	..	2	..	1	3	3	6
Foreign Countries.								
Cuba	..	..	1	..	..	1	..	1
Denmark	..	..	..	..	2	2	..	2
England	..	..	1	1	..	2	..	2
France	..	..	..	1	..	1	..	1
Mexico	..	..	..	..	3	3	3	6
New Brunswick	..	..	2	..	..	2	..	2
Nova Scotia	..	..	1	..	..	1	..	1
Quebec	..	1	..	..	..	1	1	2
Turkey	..	..	1	..	..	1	2	3
Total	9	203	178	197	279	866	332	1198

Forty States of the Union, besides the District of Columbia, are represented on our list of students. Of the total number of 1,198, 739 are from Massachusetts, or 61.6 per cent. of the whole; 109 are from other New England States; 350 are from outside New England. Of these 20 are from foreign countries.

A table showing the number of students in each year, from 1891, coming from each State or Territory, and from each foreign country, may not be without interest and instruction:

States.	1891.	1892.	1893.	1894.	1895.	1896.	1897.
Alabama	2	4	2	1	..	1	1
Arkansas	3	2	1	..	..	1	1
California	19	14	15	9	8	9	9
Colorado	7	7	5	8	7	7	8
Connecticut	30	27	30	29	27	24	30
Delaware	..	2	4	3	5	5	6
Dist. of Columbia	4	4	7	12	16	17	13
Florida	3	4	3	2	1	..	1
Georgia	2	3	3	2	2	3	4
Idaho	1	1	1	..	1	1	1
Illinois	32	40	39	36	42	45	40
Indiana	3	5	6	3	2	3	7
Iowa	10	10	13	10	12	14	12
Kansas	2	1	1	4	4	3	3
Kentucky	8	7	11	12	11	12	10
Louisiana	5	2	3	3	2	..	1
Maine	27	39	36	38	38	27	24
Maryland	7	6	4	4	9	9	8
Massachusetts	565	603	665	707	721	730	739
Michigan	13	10	7	8	7	6	5
Minnesota	13	13	11	9	5	7	8
Missouri	12	13	17	14	9	11	6
Montana	..	..	2	2	1	3	5
Nebraska	1	4	3	4	2	2	2
Nevada	3	3	2	2	..	..	..
New Hampshire	24	29	32	27	30	26	25
New Jersey	16	11	6	5	5	13	15
New Mexico	1	2	2	1	1	..	..
New York	40	50	52	59	64	69	62
North Carolina	1	1	..	..	..	1	1
Ohio	33	39	45	50	37	28	30
Oregon	1	2	1	1	1	4	3
Pennsylvania	26	25	31	37	36	42	41
Rhode Island	26	24	33	25	21	20	19
South Carolina	4	1	3	3	5	6	4
Tennessee	4	1	1	1	1	1	3
Texas	2	5	6	6	3	2	2
Utah	..	1	2	2	5	2	3
Vermont	5	4	5	3	5	7	11
Virginia	6	4	3	2	5	3	4
Washington	3	3	1	3	1	5	4
West Virginia	2	2	1	1	3	2	1
Wisconsin	7	9	11	6	7	6	6
Wyoming	..	..	..	..	..	1	..
Foreign Countries.							
Belgium	..	1	1	1	..	..	..
Brazil	4	..	..	1	1	..	..
Bulgaria	1	1	1	..	..	..	..
Central America	1	1	1	..	1	..	..
Chile	..	..	..	1	1	1	..
Columbia	2	..	..	..	..	..	..
Cuba	..	..	1	1	3	2	1
Denmark	..	..	..	..	..	..	2
England	1	1	1	..	2	2	2
France	1	1	1	..	..	1	1
Germany	..	..	2	1	..	..	..
Guatemala	..	1	..	..	..	..	..
Hawaiian Islands	4	2	2	..	..	..	..
Holland	2	2	2	2	..	..	..
Ireland	..	..	1	1	..	..	..
Japan	3	1	1	1	2	2	..
Mexico	1	1	1	1	1	3	6
New Brunswick	2	1	1	1	1	2	2
New South Wales	1	1	1	1	1	..	..
Nova Scotia	1	..	..	1	2	1	1
Ontario	2	2	4	4	2	2	..
Peru	1	..	..	..	..	..	..
Porto Rico	1	..	1	1	1	..	..
Quebec	4	5	5	2	2	2	2
Scotland	2	1	2	1	..	..	..
Spain	..	1	1	1	1	..	..
Trinidad	1	..	..	..	..	..	..
Turkey	2	1	..	1	3	1	3
Venezuela	1	..	1	1	1	1	.
Total	1011	1060	1157	1183	1187	1198	1198

Residence of Massachusetts Students.

It has been said that 61.6 per cent. of our students are from Massachusetts. All the counties of the State send students to the Institute. One hundred and twenty-four cities and towns are borne on the lists. The first column of the following table shows the number of cities and towns in each county sending pupils; the second column gives the aggregate number from each county. It appears that Middlesex sends two hundred and forty-eight and Suffolk two hundred twenty-four pupils; Essex comes third, with ninety; Norfolk, fourth, with sixty-seven.

County.	No. of Towns.	No. of Students.	County.	No. of Towns.	No. of Students.
Barnstable . .	4	6	Hampshire . .	2	2
Berkshire . . .	6	8	Middlesex . .	32	248
Bristol	5	28	Nantucket . .	1	1
Dukes	1	1	Norfolk . . .	15	67
Essex	25	90	Plymouth . . .	11	25
Franklin . . .	2	2	Suffolk	3	224
Hampden . . .	4	12	Worcester . .	13	25
			Total . . .	124	739

The following is a list of the towns, thirty-seven in number, which send four or more students to the Institute:

Boston . .	210	New Bedford,	9	Springfield .	6
Newton . .	48	Salem . . .	9	Wellesley .	6
Cambridge .	42	Brockton . .	8	Fitchburg .	5
Brookline .	25	Concord . .	8	Natick . .	5
Newburyport	22	Gloucester .	8	Peabody . .	5
Malden . .	21	Melrose . .	8	Haverhill . .	4
Somerville .	19	Winchester .	8	Milton . .	4
Lowell . .	16	Framingham .	7	Plymouth . .	4
Hyde Park .	13	Taunton . .	7	Reading . .	4
Lynn . . .	12	Waltham . .	7	Weston . .	4
Chelsea . .	11	Worcester .	7	Woburn . .	4
Arlington .	10	Fall River .	6		
Medford . .	10	Lawrence .	6		

The following table exhibits for ten years the distribution of the total number of students among two classes: First, those students whose names are found upon the Catalogue of the year preceding; and, secondly, those whose names appear first upon the Catalogue of the year to which the statement relates:

Year.	(1) Total No. of Students.	(2) No. of Students in the Catalogue of the previous year who remain in the Institute.	(3) No. of New Students entering before issue of Catalogue.	(4) Of those in column (3) the following number are regular First-year Students.	(5) No. of New Students not of the regular First-year Class.
1888–89	827	465	362	245	117
1889–90	909	557	352	255	97
1890–91	937	572	365	234	131
1891–92	1,011	624	387	258	129
1892–93	1,060	618	442	303	139
1893–94	1,157	701	456	301	155
1894–95	1,183	768	415	271	144
1895–96	1,187	778	409	266	143
1896–97	1,198	758	440	263	177
1897–98	1,198	757	441	277	164

Ages of Students on Entrance.

The next table exhibits the ages of our students upon entrance, after taking out two who are repeating the first year, and sixteen persons of unusual ages. These deductions

Period of Life.	1896–97.		1897–98.	
	Half-year Groups.	Yearly Groups.	Half-year Groups.	Yearly Groups.
16 to 16½ years . . .	2	..	1	..
16½ to 17 " . . .	3	5	1	2
17 to 17½ " . . .	19	..	16	..
17½ to 18 " . . .	40	59	33	49
18 to 18½ " . . .	52	..	45	..
18½ to 19 " . . .	44	96	39	84
19 to 19½ " . . .	41	..	58	..
19½ to 20 " . . .	28	69	25	83
20 to 20½ " . . .	23	..	25	..
20½ to 21 " . . .	9	32	9	34
21 to 22 " . . .	11	11	9	9
	272	272	261	261

leave two hundred and sixty-one as the number of students whose ages have been made the subject of computation.

The results appear in the table above in comparison with the corresponding results of 1896–97.

From the foregoing, it appears that the average age on entrance is eighteen years and eleven months.

In this connection I present the ages, at graduation, of the class leaving us in June. The one hundred and seventy-six members of the class were distributed among the different periods of life as follows:

Between 20 and 20½	1
" 20½ " 21	11
" 21 " 21½	18
" 21½ " 22	26
" 22 " 23	59
" 23 " 24	36
" 24 and over	25
Total	176

The special students this year constitute twenty-eight per cent. of the whole body, as against twenty-seven per cent. last year, and twenty-eight per cent. the year before.

Graduates of Other Colleges.

The number of students who are graduates of this and other institutions is seventy-two. Of these, ten are our own graduates, nine being candidates for advanced degrees; sixty-two are graduates of other institutions, pursuing courses of study with us, either as regular or as special students. Fourteen are graduates of Harvard University; five of Yale University; four of Williams College; three each of Georgetown University, Amherst College, and Smith College; two each of Johns Hopkins University, De Pauw University, and University of Chicago, while the following institutions are represented on our list by a single graduate each: Rochester, Minnesota, Oregon, Vermont, Princeton, Brown, Iowa State, Colby, Ohio State, and Indianapolis Universities; Carleton,

Hampden-Sidney, Central Turkey, Monmouth, Dickinson, Gonzaga, Wellesley, Boston, Tufts, Hamilton, Simpson, South Kentucky, Trinity Colleges; Colegio de Carreras.

The graduates of the Institute who are candidates for advanced degrees are Messrs. George Vincent Wendell, of the class of '92, the holder of the Savage Fellowship, in Physics, William David Coolidge, of the class of '96, the holder of the Swett Fellowship, in Physics, both studying abroad; Mr. Albert Ernest Smyser and Mr. James Swett Smyser, of the class of '96; Messrs. John Arthur Collins, Jr., Irénée du Pont, Frank Warren Everett, Edmund Sewall Manson, Jr., Theodore Ernest Videto, all of the class of '97.

Women as Students at the Institute.

The number of women pursuing courses with us is sixty-nine. Of these, five are graduates of colleges. Of the total number, five are regular students of the fourth year; one of the third year; five of the second year; five of the first year. Fifty-three are special students. Of the eleven regular students of the upper classes, three take Course IV., Architecture; four, Course V., Chemistry; two, Course VII., Biology; two, Course VIII., Physics. Of the special students, thirty devote themselves to Biology, five to Chemistry, three to Architecture, six to General Studies, three to Physics, three to Geology, one to Mathematics, and two to Sanitary Engineering.

THE COURSES OF INSTRUCTION.

The following table presents the numbers of the regular students in the second, third, and fourth years, by courses:

YEAR.	Civil Engineering.	Mechanical Engineering.	Mining Engineering and Metallurgy.	Architecture.	Chemistry.	Electrical Engineering.	Biology.	Physics.	General Course.	Chemical Engineering.	Sanitary Engineering.	Geology.	Naval Architecture.	Total.
4th Year Class.	32	41	7	29	23	40	3	6	4	10	2	..	7	203*
3d " "	40	38	8	20	19	30	2	1	1	11	1	..	11	178*
2d " "	37	40	23	22	18	20	3	2	5	15	4	1	8	197*
Total . . .	109	119	38	71	60	90	8	9	10	36	7	1	26	578*

The following table shows the figures of the total line in the foregoing table, in comparison with the corresponding figures for the next ten preceding years:

YEAR.	Civil Engineering.	Mechanical Engineering.	Mining Engineering and Metallurgy.	Architecture.	Chemistry.	Electrical Engineering.	Biology.	Physics.	General Course.	Chemical Engineering.	Sanitary Engineering.	Geology.	Naval Architecture.	Total.
1887. . . .	50	89	16	18	23	61	5	6	14	..	..	..	..	282
1888. . . .	71	100	12	21	28	74	4	5	12	11	..	..	..	338
1889. . . .	79	99	14	30	29	91	9	5	12	14	6	..	..	388
1890. . . .	79	95	18	27	27	105	11	4	13	18	7	3	..	407
1891. . . .	81	104	17	33	23	108	11	5	19	28	9	3	..	441
1892. . . .	76	106	19	37	35	112	9	5	16	34	5	3	..	457
1893. . . .	78	97	22	50	39	141	4	10	19	31	10	2	8	511
1894. . . .	88	111	19	48	50	137	5	9	19	35	13	2	20	556*
1895. . . .	88	118	25	67	59	126	7	11	14	25	10	3	22	575
1896. . . .	99	117	24	65	66	106	7	11	11	34	8	..	25	573
1897. . . .	109	119	38	71	60	90	8	9	10	36	7	1	26	578*

* Deducting those counted twice.

The following table exhibits the number of persons who have graduated within each of the several courses since the foundation of the school:

YEAR.	Civil Engineering.	Mechanical Engineering.	Mining Engineering.	Architecture.	Chemistry.	Metallurgy.	Electrical Engineering.	Natural History or Biology.	Physics.	General Course.	Chemical Engineering.	Sanitary Engineering.	Geology.	Naval Architecture.	Total.
1868	6	1	6	..	..	..	..	..	..	1	..	..	..	..	14
1869	2	2	..	..	1	..	..	..	..	..	..	..	..	..	5
1870	4	2	2	..	1	..	..	..	..	1	..	..	..	..	10
1871	8	2	5	..	2	..	..	..	..	..	..	..	..	..	17
1872	3	1	5	..	3	..	..	..	..	..	..	..	..	..	12
1873	12	2	3	1	7	..	..	..	..	1	..	..	..	..	26
1874	10	4	1	1	..	..	..	..	..	2	..	..	..	..	18
1875	10	7	6	1	1	..	..	..	1	2	..	..	..	..	28
1876	12	8	7	..	5	1	..	2	3	4	..	..	..	..	42
1877	12	6	8	4	2	..	..	..	..	..	..	..	..	..	32
1878	8	2	2	3	3	..	..	..	..	1	..	..	..	..	19
1879	6	8	3	1	3	..	..	1	1	..	..	..	..	..	23
1880	3	..	3	..	1	..	..	..	..	1	..	..	..	..	8
1881	3	5	6	3	8	..	..	1	..	2	..	..	..	..	28
1882	2	5	5	3	6	..	..	1	1	1	..	..	..	..	24
1883	3	7	5	1	3	..	..	..	..	..	..	..	..	..	19
1884	5	6	13	..	12	..	..	..	..	..	..	..	..	..	36
1885	4	6	8	2	4	..	2	..	..	1	..	..	..	..	27
1886	9	23	7	1	7	..	10	1	..	1	..	..	..	..	59
1887	10	17	8	1	9	..	8	1	1	3	..	..	..	..	58
1888	11	25	4	5	10	..	17	3	1	1	..	..	..	..	77
1889	15	23	5	3	8	..	17	1	1	2	..	..	..	..	75
1890	25	27	3	5	13	..	18	3	2	6	..	..	..	..	102
1891	18	26	4	6	11	..	23	3	3	1	7	..	1	..	103
1892	22	26	4	13	7	..	36	6	1	7	4	6	1	..	133
1893	25	30	5	2	8	..	41	2	..	6	8	..	2	..	129
1894	21	31	4	14	11	..	33	1	3	5	12	3	..	..	138
1895	25	30	3	15	14	..	33	..	2	4	11	4	..	5	144*
1896	25	34	10	24	16	..	48	3	3	7	7	4	3	5	188*
1897	25	40	7	16	20	..	33	2	3	7	12	4	1	9	179
Totals	344	406	152	125	196	1	319	31	26	67	61	21	8	19	1,773
Deduct names counted twice															11
Net total															1,762

* Deducting names counted twice.

The following table shows, by classes and by courses, the number of regular students who have registered themselves as electing to distribute the required studies and exercises over the period of five years:

Year.	Total.	Course.												
		I.	II.	III.	IV.	V.	VI.	VII.	VIII.	IX.	X.	XI.	XII.	XIII.
1st . .	4	..	..	..	..	..	..	..	..	..	..	..	..	..
2d . .	7	..	3	..	1	..	1	1	..	1	..	..	..	..
3d . .	6	1	3	..	2	..	..	..	..	..	..	..	..	..
4th . .	10	2	3	..	1	1	2	..	..	..	..	..	..	1
5th . .	10	..	1	1	1	..	3	..	1	1	1	..	..	1
	37	3	10	1	5	1	6	1	1	2	1	0	0	2

Classification of Special Students.

Our special students can, of course, not be classified systematically; but the following table exhibits the number of such students pursuing certain leading lines of study:

Applied Mechanics . .	65	Language	172
Architecture	60	Mathematics	147
Biology	51	Mechanical Engineering .	77
Chemistry	134	Mining Engineering . .	12
Civil Engineering . . .	46	Naval Architecture . . .	2
Drawing	158	Physics	168
Electrical Engineering .	15	Political Science . . .	61
English	133	Sanitary Engineering . .	6
Geology	46	Shopwork	74
History	100		

The following is the number of students, either regular or special, pursuing certain leading branches of study, in each of the four years, as follows:

	First Year.	Second Year.	Third Year.	Fourth Year.	Total.
Mathematics. . .	308	308	115	47	778
Chemistry	371	55	83	55	564
English	299	274	13	6	592
French	162	84	50	....	296
Physics	....	287	278	227	792
German	81	208	149	5	443
Shopwork	11	110	50	67	238

THE SOCIETY OF ARTS.

REPORT OF THE SECRETARY.

To the President of the Institute:

SIR: On behalf of the Executive Committee of the Society of Arts, I beg to submit the Annual Report of the proceedings of the Society for the year 1896–97, as required by the By-laws.

At the adjourned annual meeting held May 27, 1897, Messrs. George W. Blodgett, Desmond FitzGerald, Thomas Doane, Edmund H. Hewins, and Frank W. Hodgdon were duly elected members of the Executive Committee, and Dr. Robert P. Bigelow was reëlected secretary for the ensuing year. The Executive Committee presented the following report, which was accepted and placed on record:

With the close of this thirty-fifth year of its existence, the Society of Arts has passed its five hundredth meeting. During the present year there have been held fourteen meetings, at which sixteen papers have been read. One meeting was a special one, held jointly with the Boston Society of Civil Engineers, to listen to a paper on the "Tampico Harbor Works" by the eminent engineer, Mr. E. L. Corthell. Three notable papers have been presented showing the summer work of the Institute. One of these was by Professor Homer, on the "Summer School of Architecture in Europe." The other two were by Professors Burton and Barton on the results obtained by the "Boston Party on the Sixth Peary Expedition to Greenland." All three of these papers will be published in the current volume of the "Technology Quarterly," and in addition to these an exceptionally valuable article on the "Pendulum and Magnetic Observations" has been contributed by Mr. Putnam, a member of the Boston

party. Another paper that deserves special mention, both because of its intrinsic value and because it embodied the results of original work done by a member of the Society, and largely in the laboratories of the Institute, is the one read by Dr. Williams on "Some Applications of the Röntgen Rays."

The endeavor has been made to publish the papers presented before the Society, as far as possible, in the "Technology Quarterly," but some papers have been crowded out or have been much delayed, owing to lack of space. As it is, the size of the last two numbers of the "Quarterly" has been much greater than the finances of the Society will warrant, and future numbers will have to be much smaller, even if that necessitates the omission of valuable contributions. The Results of Tests made in the Engineering Laboratories are regarded as an especially valuable feature of the "Quarterly," and although a source of very considerable expense, it is hoped that it will be possible to continue their publication.

The most momentous event in the history of the Society during the year is the death of President Walker, which has been felt more keenly, perhaps, by the members of the Executive Committee than by the other members of the Society, for their duties brought them into closer personal relations with him, and they have been better able to observe the thoughtful interest and wide knowledge of affairs that General Walker brought to the aid of the Committee in its efforts to guide the course of the Society.

At the time of the previous annual meeting the Society had 67 life members. Seven of these have died during the year, leaving 60 as the present number. The number of associate members a year ago was 289. Three have died and 9 have resigned. This loss is more than offset by the addition of 34 new members; making the present number of associate members 311.

The life members who have died during the year are Thomas T. Bouvé, George O. Carpenter, William O. Grover, Henry D. Hyde, G. F. H. Markoe, O. W. Peabody, John

Ruggles, and George W. Wales; the associate members are Henry A. Craigin, James H. Stanwood, and Francis A. Walker.

Respectfully submitted,

ROBERT P. BIGELOW,
Secretary.

DEC. 4, 1897.

THE TECHNOLOGY CLUB.

In the report of last year, reference was made by President Walker to the recently formed Technology Club, although, as he stated, it does not come strictly within the cognizance of the Corporation. The experience of the year has demonstrated, however, even beyond the expectations of the promoters of this Club, the usefulness to the Institute of such a meeting-place for the members of its governing and teaching bodies and its past students. Not simply through the ordinary intercourse of club life, but more especially by the frequent social meetings and class dinners that have been held in the club-house, an extraordinary interest in the work of the Institute has been aroused among its past members, and very active forces for the promotion of its welfare have been set in motion.

The use of the rooms of the Club for various minor purposes of the School is, in itself, of much value to us; and by its policy of admitting a number of undergraduates to full membership, the Club is contributing in no slight degree to the promotion of good order and of high ideals within the student body.

For these and other reasons I am convinced that the Technology Club, while not an integral part of our organization, should receive the cordial support of all who are concerned in promoting the welfare of the Institute.

A number of classes that had never come together since their graduation have organized, and have reunited their

scattered members, with the result that many to whom the Institute of Technology had been but a name have become its zealous and intelligent supporters.

The Association of Class Secretaries. — In connection with the Technology Club an important step has been taken in the organization of the Association of Class Secretaries. This association includes the secretaries of the various graduate classes, and has added also to its membership representatives of the Alumni Association, of the Technology Club, of the undergraduates, and the Secretary of the Institute.

The object of the society is "to promote class spirit and the welfare of the Institute, and to systematize all matter pertaining to class organization and record."

In pursuance of these objects it has through committees prepared careful plans for the systematic conduct of the business of alumni classes, and has effected the formation of organizations where none had existed before, and has revived the interest of others which had been long dormant.

TREASURER'S REPORT.

STATEMENT OF THE TREASURER.

THE treasurer submits the annual statement of the financial affairs of the Institute for the year ending September 30, 1897.

The amount paid for salaries increased about six thousand dollars, and there was also an increase in the repair account to the amount of about two thousand dollars.

Savings have been made in the payments for fuel, supplies, and some other matters to the amount of about seven thousand dollars.

The net result is that the income, including the twenty-five thousand dollars received from the State of Massachusetts, has just about equalled the expenses — there being a deficit of only four hundred and twenty-five dollars and four cents.

From the John W. and Belinda Randall Charities Corporation there have been received fifty thousand dollars.

Seven thousand four hundred and eighty-five dollars and ninety-one cents have been added to the Ann White Vose Scholarship Fund by a final payment from her estate.

Similarly a supplementary payment of nine hundred and twenty-three dollars and thirty-three cents has been received from the estate of the late Susan E. Dorr; and one of one hundred and ninety-six dollars and twenty-one cents from that of the late Samuel E. Sawyer.

Mrs. Wm. B. Rogers has kindly given two hundred dollars for periodicals; and other gifts, amounting in all to nine hundred and twenty-five dollars, have come from other friends of the Institute.

The debt has been reduced during the last year from one hundred and fifty thousand dollars to one hundred and twenty thousand.

SECURITIES EXCHANGED, W. B. ROGERS MEMORIAL FUND.

$50,000 Saginaw & Western R.R. 6s.	50,000.00

RECEIVED.

$37,500 Detroit, Grand Rapids & Western R.R. 4s., 1946 .	37,500.00
255 shares " " " " " " Pf'd .	12,500.00

SECURITIES SOLD OR PAID, GENERAL ACCOUNT.

16 Rights Boston Real Estate Trust	100.00
$1,000 Bur. & Missouri R.R. 6s., 1918	1,000.00

SECURITIES BOUGHT OR RECEIVED AS LEGACIES, GENERAL ACCOUNT.

$1,000 Bur. & Missouri R.R. 6s., 1918, non-exempt . . .	1,077.50
1 share Boston Ground Rent Trust	900.00

GEORGE WIGGLESWORTH, TREASURER, *in account with*
GENERAL STATEMENT OF RECEIPTS AND DISBURSEMENTS

Dr.

Cash balance Sept. 30, 1896		22,323.15
From Augustus Lowell for Lowell Courses	5,700.00	
" " " " C. Kastner's salary	2,500 00	
" " " " School of Design	500 00	
		8,700.00
RECEIPTS FOR CURRENT EXPENSES.		
Income of funds for salaries	3,942.00	
" " " " scholarships (students' fees)	6,400.00	
" " " " Joy "	200 00	
" " " " Swett "	400 00	
" " " " Savage "	400.00	
" " " " Library	540.00	
" " " " general purposes	9,196.43	
" " Rogers Memorial Fund	9,814.00	
" " Charlotte B. Richardson Fund	1,682.04	
" " Rotch Prize Funds	450.00	
Letter Box Fund used 1896 [59.75]	175.00	
Biological Instrument Fund used 1896	356 50	
Mathematical Department Fund used 1896	250.00	
Students' fees	215,045.00	
State Scholarships	4,000.00	
State Agricultural Fund	5,896.00	
State Endowment Fund	7,666.67	
Gift of State of Massachusetts	25,000.00	
Laboratory supplies and breakages	9.902.17	
Rents, per Table (page 84)	15,274.23	
Gifts	1,125.00	
Interest	5,020.58	
Boston University	1,150.00	
Sale printed Lecture Notes	2,753.28	
		326,638.90
GIFTS AND BEQUESTS FOR SPECIAL PURPOSES.		
Increase Richard Perkins Fund	103.50	
" James Savage Fund	178.38	
" Susan Upham Fund	53.66	
" Dalton Graduate Chem. Fund	229.05	
" T. Sterry Hunt Fund	138.72	
" James H. Mirrlees Fund	120.41	
" W. B. Rogers Fund [additional 52]	277.93	
Susan E. Dorr Fund [" 923.33]	1,085.15	
Ann White Vose Fund [" 7,485.91]	7,949.80	
		10,136.60
GIFTS AND BEQUESTS FOR GENERAL PURPOSES.		
Samuel E. Sawyer Legacy, additional	196.21	
John W. & Belinda Randall Fund	50,000.00	
		50,196.21
SECURITIES SOLD OR PAID. GENERAL FUND, page 75		1,100.00
SUNDRIES.		
Income credited to Bond Premium Acc't	495.40	
Income credited to Rogers Bond Premium Acc't	500 00	
Boston Art Students' Asso. on acc't	666.67	
Students' notes paid	937.50	
		2,599.57
		$421,694.43

MASSACHUSETTS INSTITUTE OF TECHNOLOGY.

FOR THE YEAR ENDING SEPTEMBER 30, 1897.

Cr.

Paid for Lowell Courses	5,700.00	
" " Charles Kastner's salary	2,500.00	
" " Expense Lowell School of Design	500.00	
		8,700.00

EXPENSES.

Salaries, per Table (page 84)	222,744.42	
" paid from Gifts	500.00	
Fellowship paid from Swett Fund	400.00	
" " " Savage "	400.00	
Prizes, Rotch Funds	450.00	
Repairs, per Table (page 85)	11,232.57	
General Expenses, per Table (page 85)	14,122.07	
Fuel	6,600.48	
Water	2,020.40	
Gas	2,241.35	
Electricity	1,111.27	
Printing and Advertising	2,463.42	
" Lecture Notes	1,697.38	
" Annual Catalogues and Reports	2,790.53	
Rents paid Boston & Albany R.R. Co.	180.00	
" " Natural History Society	200.00	
Laboratory Supplies and Libraries, per Table (page 84)	34,885.28	
Society of Arts	2,164.60	
Interest allowed on funds not in Bonds and Stocks, at 4½ per cent	6,662.05	
Interest paid A. Lowell, Trustee	1,000.00	
" " on Mortgage Notes	4,630.00	
Mech. Eng. & Applied Mechanics Department Improvements	2,657.89	
Physical Department Improvements	4,310.58	
Architectural " "	993.15	
Mathematical Department	250.00	
Biological Instrument Department	356.50	
		327,063.94

[Expenses more than Income, $425.04]

SECURITIES BOUGHT OR RECEIVED AS LEGACIES. GENERAL ACCOUNT, page 75		1,977.50
Projected Building, Trinity Place, plans		74.07

SUNDRIES.

Notes Payable	30,000.00	
Notes Receivable	17,000.00	
Students' Deposits	250.00	
Funds of 1896, used	666.25	
		47,916.25
Cash balance, Sept. 30, 1897		35,962.67
		$421,694.43

The following account exhibits the property held by the Institute, as per Treasurer's books, Sept. 30, 1897:—

INVESTMENT OF THE W. B. ROGERS MEMORIAL FUND.

$30,000.00	Burlington & Mo. River R.R. 4s.	1910	25,787.50	
27,000.00	Kansas City Belt R.R. 6s.	1916	27,000.00	
16,000.00	Kansas City, Clinton & Springfield R.R. 5s.	1925	16,000.00	
6,000.00	New York & New England R.R. 6s.	1905	6,000.00	
5,400.00	Republican Valley R.R. 6s.	1919	5,400.00	
4,000.00	Cin., Ind., St. Louis & Chicago R.R. 6s.	1920	4,000.00	
2,000.00	Ottawa, Oswego & Fox River R.R. 8s.	1900	2,000.00	
2,000.00	Kansas City, Fort Scott & Gulf R.R. 7s.	1908	2,000.00	
3,000.00	Kansas City, Memphis & Birmingham R.R.			
	1,000 General Mortgage 4s.	1934		
	2,000 Income 5s.	1934		
			2,221.40	
1,000.00	Lincoln & Northwestern R.R. 7s.	1910	1,000.00	
1,000.00	Atchison & Nebraska R.R. 7s.	1908	1,000.00	
42,000.00	Chicago, Burlington & Quincy R.R. Conv. 5s.	1903	40,820.00	
35,000.00	Fort Street Union Depot 4½s.	1941	34,825.00	
24,000.00	Rome, Watertown & Ogdensburg R.R. 5s	1922	24,000.00	
37,500.00	Detroit, Grand Rapids & Western R.R. 4s.	1946	37,500.00	
	255 Shares Detroit, Grand Rapids & Western Pfd., par 100		12,500.00	
	Advance to Bond Premium account		7,900.00	
	Bonds and Stocks			249,953.90

INVESTMENT OF THE JOY SCHOLARSHIP FUND.

	Massachusetts Hospital Life Insurance Co.	5,000.00	
	Deposits in Savings Banks	4,123 70	
			9,123.70

INVESTMENT SWETT SCHOLARSHIP FUND.

	Massachusetts Hospital Life Insurance Co.	10,000.00

INVESTMENTS, GENERAL ACCOUNT.

$14,000.00	Bur. & Mo. River (Neb.) R.R. 6s., non-exempt	1918	14,000.00	
2,000.00	Bur. & Mo. River (Neb.) R.R. 6s., exempt	1918	2,000.00	
6,000.00	Chicago, Burlington & Quincy R.R. 4s.	1922	5,100.00	
3,000.00	Milwaukee & St. Paul R.R. 7 3-10	1898	3,000.00	
4,000.00	Chicago, Burlington & Northern R.R. 5s.	1926	4,000.00	
2,000.00	Kansas City, Fort Scott & Gulf R.R. 7s.	1908	2,000.00	
3,000.00	Hannibal & St. Joseph R.R. 6s.	1911	3,000.00	
15,000.00	Chicago, Burlington & Quincy R.R. Conv. 5s.	1903	15,000.00	
6,000.00	West End Street Ry. 5s	1902	6,000.00	
2,000.00	Brookline Gas Light Co. 5s.	1913	2,000.00	
35,000.00	Fitchburg R.R. 5s.	1903	35,000.00	
65,000.00	Boston & Maine R.R. 4½s.	1944	65,000.00	
26,000.00	Am. Dock & Improvement Co. 5s.	1921	26,000.00	
3,000.00	Illinois Central R.R. 4s.	1951	3,000.00	
5,000.00	New York & New England R.R. 6s.	1905	5,000.00	
	Advances to Bond Premium account		5,121.94	
	Bonds			195,221.94
	Amount carried up			$464,299.54

Amount brought up					464,299.54

STOCKS.

SHARES.					
148	Boston & Albany R.R.	par	100	29,933.00	
194	Morris & Essex R.R.	"	50	14,690.00	
40	New York & Harlem R.R.	"	50	5,000.00	
85	Pittsburg, Fort Wayne & C. R.R.	"	100	12,880.00	
50	N.Y., New Haven & Hartford R.R.	"	100	8,000.00	
12	Cocheco Manufacturing Co.	"	500	6,000.00	
56	Hamilton Woollen Co.	"	100	5,390.00	
59	Everett Mills	"	100	5,310.00	
31	Great Falls Manufacturing Co.	"	100	3,472.00	
6	Manchester Mills	"	100	660.00	
2	Dwight Manufacturing Co.	"	500	1,600.00	
1	Merrimack Manufacturing Co.	"	1000	1,015.00	
1	Laconia Co.	"	400	605.00	
2	Pepperell Manufacturing Co.	"	500	2,300.00	
10	Lowell Bleachery	"	100	975.00	
27	Essex Co.	"	50	3,780.00	
158	Pennsylvania Coal Co.	"	50	23,160.50	
15	Consolidated Gas Co., New York	"	100	1,447.50	
7	Lowell Gas Light Co.	"	100	1,610.00	
40	Cambridge Gas Light Co.	"	100	7,000.00	
7	Lawrence Gas Light Co.	"	100	882.00	
55	Old Boston National Bank	"	100	5,510.50	
15	Merchants' National Bank	"	100	2,220.00	
25	New England National Bank	"	100	3,875.00	
25	Atlantic National Bank	"	100	2,875.00	
10	National Union Bank	"	100	1,240.00	
25	National Bank of the Republic	"	100	3,625.00	
40	The Molsons Bank, Montreal	"	50	3,000.00	
37	Nat. Mechanics Bank, Baltimore	"	10	706.70	
10	First Nat. Bank of Baltimore	"	100	1,293.30	
16	Boston Real Estate Trust	"	1000	18,300.00	
1	Boston Ground Rent Trust	"	1000	900.00	
					179,255.50

REAL ESTATE.

Rogers Building		200,000.00	
Walker "		150,000.00	
Land on Garrison Street	50,840.00		
Workshops " "	30,000.00		
		80,840.00	
Land on Trinity Place	76,315.69		
Engineering B'ld'g, Trinity Place .	90,000.00		
		166,315.69	
Gymnasium Building		7,967.85	
Architects' "		57,857.10	
Lot No. 2, Trinity Place		137,241.60	
Projected Building, Trinity Place, plans . . .		243.57	
Clarendon St. Land and Building		142,762.94	
House No. 34 Commonwealth Ave.		30,000.00	
Real Estate, Massachusetts Ave., Cambridge .		16,154.38	
			989,383.13
Equipment, Engineering Building		16,555.24	
" Workshops		20,628.56	
			37,183.80

SUNDRIES.

Notes Receivable		78,500.00	
Boston Art Students' Association		12,333.33	
Students' Notes		1,845.50	
Cash Balance, Sept. 30, 1897		35,962.67	
			128,641.50
			$1,798,763.47

The foregoing property represents the following Funds and Balances, and is answerable for the same.

The income of the following is used for the general purposes of the Institute:

William Barton Rogers Memorial Fund	250,225.00	
Richard Perkins Fund	50,000.00	
George Bucknam Dorr Fund	49,573.47	
Martha Ann Edwards "	30,000.00	
Nathaniel C. Nash "	10,000.00	
Sidney Bartlett "	10,000.00	
Robert E. Rogers "	7,680.77	
Albion K. P. Welch "	5,000.00	
Stanton Blake "	5,000.00	
McGregor "	2,500.00	
Katharine B. Lowell "	5,000.00	
Samuel E. Sawyer "	4,610.87	
John W. and Belinda Randall Fund	50,000.00	
		479,590.11

The income of the following is used towards paying salaries: —

Nathaniel Thayer, for Professorship of Physics	25,000.00	
Jas. Hayward, for Professorship of Engineering	18,800.00	
William P. Mason " Geology	18,800.00	
Henry B. Rogers, for General Salaries	25,000.00	
		87,600.00

SCHOLARSHIP TRUSTS.

Richard Perkins Fund	53,278.67	
James Savage Fund	13,431.20	
Susan H. Swett Fund	10,182.95	
William Barton Rogers Fund	10,652.20	
Joy Fund	9,123.70	
Elisha Thatcher Loring Fund	5,329.39	
Charles Lewis Flint Fund	5,253.93	
Thomas Sherwin Fund	5,000.00	
Farnsworth Fund	5,000.00	
James H. Mirrlees Fund	2,796.19	
William F. Huntington Fund	5,208.33	
T. Sterry Hunt Fund	3,221.46	
Elisha Atkins Fund	5,000.00	
Nichols Fund	5,000.00	
Ann White Vose Fund	61,182.16	
Dalton Grad. Chemical Fund	5,319.05	
		204,979.23

OTHER TRUSTS.

Charlotte Billings Richardson, Industrial Chemistry Fund	37,378.78
Susan Upham Fund	1,246.13
Susan E. Dorr Fund	3,757.80
William Hall Kerr, Library Fund	2,000.00
Biological Instrument Fund	143.50
Charles Lewis Flint, Library Fund	5,000.00
Rotch Arch. Library Fund	5,000.00
Rotch Architectural Fund	25,000.00
Rotch Prize Fund	5,225.00
Rotch " Special " Prize Fund	5,225.00
Letter-box Fund, balance	110.37

MISCELLANEOUS.

Notes Payable	120,000.00	
Students' Deposits	250.00	
Catherine P. Perkins Legacy, 1893	102,781.40	
Henry E. Hutchins Legacy, 1895	2,000.00	
Moses Kimball Legacy, 1896	5,000.00	
Benjamin P. Cheney Legacy, 1896	10,000 00	
Susan G. Coolidge Devise, 1896	14,005.00	
M.I.T. Stock Account	681,976.15	
		936,507.55
		$1,798,763.47

Comparative Statement of Funds, etc.

	Sept. 30, 1896.	Sept. 30, 1897.
Trusts for general purposes	429,393.90	479,590.11
" " Salaries	87,600 00	87,600.00
" " Scholarships	195,981.44	204,979.23
" " Library	7,000.00	7,000.00
Charlotte B. Richardson Ind. Chem. Fund	37,378.78	37,378.78
Susan Upham Fund	1,192.47	1,246.13
Susan E. Dorr Fund	2,672.65	3,757.80
Rotch Architectural Library Fund	5,000.00	5,000.00
Rotch Architectural Fund	25,000.00	25,000.00
Rotch Prize Fund	5,225.00	5,225.00
Rotch "Special" Prize Fund	5,225.00	5,225.00
Catherine P. Perkins Legacy	102,781.40	102,781.40
Henry E. Hutchins "	2,000.00	2,000 00
Moses Kimball "	5,000.00	5,000.00
Benj. P. Cheney "	10,000.00	10,000.00
Susan G. Coolidge Devise	14,500 00	14,500.00
Letter-box Fund	170.12	110.37
Biological Instrument Fund	500.00	143.50
Mathematical Department Fund	250.00	
Students' Deposits	500.00	250.00
Notes Payable	150,000.00	120,000.00
M.I.T. Stock Account	682,401.19	681,976.15
	$1,769,771.95	$1,798,763.47
Increase		
Consisting of:—		
Bequests for Special Purposes, etc. See page 76		10,136.60
Gifts and Bequests for General Purposes. See page 76		50,196.21
		60,332.81
Less Notes Payable Paid	30,000.00	
" Biological Instrument Fund used	356.50	
" Mathematical Department Fund used	250.00	
" Letter-box Fund used	59.75	
" Students' Deposits	250.00	
" Expenses more than Income	425.04	
		31,341.29
		$28,991.52

INCOME FROM GENERAL INVESTMENTS, AND APPLICATION THEREOF.

Applied to Salaries	3,942.00	From Dividends, Bank Stocks	1,154.80
" " Scholarships	6,400.00	" State Tax returned on Bank Stocks	237.21
" " " James Savage Fund	400.00	" Bonds	9,470.17
" " Charlotte B. Richardson Fund	1,682.04	" Dividends, Railroad Stocks	3,098.00
" " Rotch Prize Funds	450.00	" " Coal and Gas Stocks	2,305.00
" " Library	540.00	" " Manufacturing Stocks	966.00
" " General Purposes	9,196.43	" Real Estate Stocks	738.00
" " Increase of Funds	1,525.36	" Interest allowed on Funds not in Bonds and Stocks @ 4½ %	6,662.05
" " Advances to Bond Premiums	495.40		
	$24,631.23		$24,631.23

INCOME FROM WILLIAM BARTON ROGERS MEMORIAL FUND, AND APPLICATION THEREOF.

Paid Massachusetts Institute of Technology .	9,814.00	Received Income from Railroad Bonds . . .	10,314.00
Credited to Advances Bond Premiums . . .	500.00		
	$10,314.00		$10,314.00

DETAILS OF SOME ITEMS IN TREASURER'S CASH ACCOUNT.

Rents.

Huntington Hall, for Lowell Lectures			3,500.00	
Lowell School of Design			1,800.00	
Chauncy Hall School, for Gymnasium			150.00	
State Board of Health, for use of Laboratories			375.00	
Land and Building, Clarendon St., on account			8,250.00	
34 Commonwealth Avenue, 1 year		2,200.00		
less Annuity under Will		1,000.00		
less Tax		357.33		
		1,357.33		
			842.67	
Use of Rooms and Gymnasium			1,177.75	
Mass. Ave., Cambridge			366.66	
			16,462.08	
less Tax and Repairs, Cambridge			1,187.85	
				15,274.23

Department Supplies.

Chemistry	9,286.58	
Physics	6,723.37	
Mining	1,613.07	
Mechanical Engineering	2,789.82	
Naval Architecture	571.24	
Applied Mechanics	1,766.09	
Civil Engineering	2,931 04	
Biology	1,242.73	
Geology	778.50	
Architecture	2,062.25	
Drawing	55.16	
Mathematics	135.63	
English	1,180.26	
Workshops	1,767.91	
Modern Languages	43.32	
Periodicals	1,707.64	
Military	230.67	
		34,885.28

Salaries.

Instruction	183,337.99	
Administration	20,393.24	
Labor	19,013.19	
		222,744.42

Repairs.

Department Improvements: —			
Chemistry	1,376.11		
Mining	541.93		
Physics	471.04		
Workshops	419.29		
Mechanical Engineering	254.64		
Civil Engineering	161.95		
English	156.40		
Architecture	109.18		
Biology	92.93		
Applied Mechanics	85.89		
Geology	30.28		
Naval Architecture	22.54		
Drawing	17.50		
Military	13.37		
Mathematics	11.75		
		3,764.80	
Rogers Building		2,423.49	
Sundries		1,278.39	
Walker Building		1,249.46	
Steam Fitting		935.65	
Boilers, Tools, etc.		837.49	
Architectural and Engineering Buildings		580.15	
Gymnasium		163.14	
			11,232.57

General Expenses.

Stationery and Office Supplies	1,844.27	
Fire Insurance	1,726.96	
Postage	1,310.00	
Hawley Furnace	1,200.00	
Electric Wiring	1,144.39	
Washing	759.63	
Diplomas	752.85	
Entrance Examinations	716.09	
Sundries	608.01	
Janitor's Supplies: Brushes, Pails, etc.	482.55	
Express Charges, Teaming, etc.	414 88	
Furniture	378.67	
Paints, Varnish, etc.	375.07	
Glass	286.48	
Examination Books	281.25	
Engine Room Supplies: —		
Oil	184.08	
Cotton Waste	61.03	
Sundries	30.24	
	275.35	
Ice	273.54	
Window Shades	217.31	
Vacuum Pump	212.85	
Lowell School of Design	193.32	
Books, Supplies, etc., for General Library	158.73	
Water-Pipe (Street)	150.00	
Type-writing Machine	112.86	
Gymnasium Supplies	92.68	
Telephone & Telegraph Co.	77.33	
Union Deposit Vaults	50.00	
Western Union Telegraph Co.	27.00	
		14,122.07

BOSTON, December 6, 1897.

An examination of the accounts of the Treasurer of the MASSACHUSETTS INSTITUTE OF TECHNOLOGY for the year ending September 30, 1897, has been made by E. A. Stone, an accountant employed by this committee. Mr. Jackson and Mr. Tolman, the members of the committee on that date, have verified the evidences of personal property held by the Institute.

The report of Mr. Stone is hereto annexed.

JAMES P. TOLMAN,
WILLIAM L. PUTNAM, } *Members of the Auditing Committee.*

[The absence in California of Mr. Jackson prevents his signing this report.]

BOSTON, December 6, 1897.

To the Auditing Committee of the Massachusetts Institute of Technology:

GENTLEMEN: I have completed the examination of the Treasurer's accounts for the year ending September 30, 1897, and find them to be correct. I have also verified the bank balances. The trial balance corresponds with the ledger balances, and the same agree with the Treasurer's report, as printed.

Yours truly,

EDWIN A. STONE,
Accountant.

MASSACHUSETTS INSTITUTE OF TECHNOLOGY

ANNUAL REPORT

OF THE

PRESIDENT AND TREASURER,

DECEMBER 14, 1898.

BOSTON:
ROCKWELL AND CHURCHILL PRESS.
1899.

Members of the Corporation.

President.
JAMES M. CRAFTS.

Secretary.[1]
FRANCIS H. WILLIAMS.

Treasurer.
GEORGE WIGGLESWORTH.

JOHN D. RUNKLE.
WILLIAM ENDICOTT, JR.
AUGUSTUS LOWELL.
HOWARD A. CARSON.
CHARLES J. PAINE.
CHARLES FAIRCHILD.
DAVID R. WHITNEY.
ALEXANDER S. WHEELER.
JAMES P. TOLMAN.
HOWARD STOCKTON.
ELIOT C. CLARKE.
NATHANIEL THAYER.
CHARLES F. CHOATE.
HIRAM F. MILLS.
PERCIVAL LOWELL.
ARTHUR T. LYMAN.
CHARLES MERRIAM.
THORNTON K. LOTHROP.
CHARLES C. JACKSON.
SAMUEL M. FELTON.
DESMOND FITZGERALD.
SAMUEL CABOT.
FRANCIS BLAKE.
CHARLES W. HUBBARD.
THOMAS L. LIVERMORE.
A. LAWRENCE ROTCH.
JOHN R. FREEMAN.
GEORGE A. GARDNER.
WILLIAM H. LINCOLN.
J. B. SEWALL.
THOMAS GAFFIELD.
CHARLES L. LOVERING.
A. LAWRENCE LOWELL.
SAMUEL JOHNSON.
JAMES P. MUNROE.
WILLIAM L. PUTNAM.
CHARLES G. WELD.
EBEN S. DRAPER.
ROBERT S. PEABODY.
ELIHU THOMSON.

On the Part of the Commonwealth.

HIS EXCELLENCY GOV. ROGER WOLCOTT.
HON. WALBRIDGE A. FIELD, *Chief Justice of the Supreme Court.*
HON. FRANK A. HILL, *Secretary of the Board of Education.*

[1] Communications should be addressed to the Secretary of the Institute.
(See page 16.)

Committees of the Corporation.

Executive Committee.

JAMES M. CRAFTS. } *Ex Officiis.*
GEORGE WIGGLESWORTH. }

THOMAS L. LIVERMORE. ALEXANDER S. WHEELER.
AUGUSTUS LOWELL. HOWARD STOCKTON.
FRANCIS H. WILLIAMS.

Finance Committee.

WILLIAM ENDICOTT, Jr. CHARLES C. JACKSON.
DAVID R. WHITNEY. NATHANIEL THAYER.
SAMUEL JOHNSON.

Committee on the Society of Arts.

HOWARD A. CARSON. GEORGE A. GARDNER.
HIRAM F. MILLS.

Committee on the Lowell School of Industrial Design.

PERCIVAL LOWELL. JOHN D. RUNKLE.
WILLIAM H. LINCOLN.

Auditing Committee.

CHARLES C. JACKSON. JAMES P. TOLMAN.
WILLIAM L. PUTNAM.

Committee on Nominations.

AUGUSTUS LOWELL. DAVID R. WHITNEY.
HOWARD STOCKTON. GEORGE A. GARDNER.
HOWARD A. CARSON.

Trustees of the Museum of Fine Arts.

JAMES M. CRAFTS. A. LAWRENCE ROTCH.
FRANCIS BLAKE.

Visiting Committees.

Department of Civil Engineering.

HOWARD A. CARSON. ELIOT C. CLARKE.
CHARLES F. CHOATE. DESMOND FITZGERALD.
JOHN R. FREEMAN.

Departments of Mechanical Engineering and Applied Mechanics.

HIRAM F. MILLS. FRANCIS BLAKE.
DESMOND FITZGERALD. JAMES P. TOLMAN.

Departments of Mining and Geology.

THOMAS L. LIVERMORE. JAMES P. TOLMAN.
CHARLES FAIRCHILD. CHARLES L. LOVERING.

Department of Architecture.

THORNTON K. LOTHROP. JOHN R. FREEMAN.
ELIOT C. CLARKE. A. LAWRENCE ROTCH.

Department of Physics and Electrical Engineering.

FRANCIS BLAKE. A. LAWRENCE ROTCH.
CHARLES W. HUBBARD. DESMOND FITZGERALD.

Departments of Literature, History, and Political Economy.

FRANK A. HILL. CHARLES C. JACKSON.
J. B. SEWALL. A. LAWRENCE LOWELL.
JAMES P. MUNROE.

Department of Modern Languages.

J. B. SEWALL. NATHANIEL THAYER.
FRANK A. HILL. THORNTON K. LOTHROP.

Department of Mathematics.

PERCIVAL LOWELL. WILLIAM L. PUTNAM.
HOWARD STOCKTON. CHARLES F. CHOATE.

Departments of Chemistry and Biology.

SAMUEL CABOT. THOMAS GAFFIELD.
FRANCIS BLAKE.

Department of Chemical Engineering.

ARTHUR T. LYMAN. SAMUEL CABOT.
HIRAM F. MILLS. CHARLES W. HUBBARD.

Department of Naval Architecture.

CHARLES J. PAINE. WILLIAM H. LINCOLN.
HOWARD STOCKTON. CHARLES G. WELD.

To the Corporation of the Massachusetts Institute of Technology:

The past year has been to our Institute an *annus mirabilis*. The Treasurer's report shows an accession of $928,000 to the general funds of the Institute, and of $46,000 to the scholarship funds, and lately we have news of a legacy of $400,000 for the aid of scholars and teachers.

The Pierce Building has been built and made ready for occupation this autumn, and on the other hand we have suffered loss by fire in the adjoining building.

Death has removed one of the original charter members of the Corporation, and also a veteran friend of the Institute who long served on its finance committee.

The funds mentioned above are:

Estate of Henry L. Pierce	$750,000 00
" " Julia B. Huntington James	140,500 00
" " John W. Carter	6,250 00
" " John Foster	10,000 00
" " Susan E. Dorr	1,482 78
Gift from George A. Gardner	20,000 00
For scholarships:	
Estate of Ann White Dickinson	40,000 00
" " Willard B. Perkins	6,000 00

The confidence which the donors have displayed by making no restrictions upon the use of gifts is gratifying evidence of their trust in the wise administration of our school, and it greatly helps our endeavors to meet the pressing needs of the day.

The fact that Mr. Edward Austin's very generous bequest of $400,000 was made without solicitation, and that the donor had no immediate connection with the Institute, may be taken as a proof that the recognition of our usefulness is becoming more widespread in the community. For many years Mr.

Austin had been in the habit of rendering pecuniary assistance to students whom he thought worthy, and, at the age of ninety-four, set aside by will a large share of his property to be employed forever in aid of education. The will provides that the interest shall be paid to needy and meritorious students and teachers, to assist them in the payment of their studies.

In consequence of this bequest the proportion of income devoted to scholarships will be increased relatively to that available for general purposes, and we believe that ample provision is now made for the probable needs of young men who are unable to pay tuition fees and who at the same time are properly fitted to receive our education.

The chief desideratum for the immediate future is an augmentation of the funds for general purposes to aid in the continued progress of the school, and the introduction of higher branches of industrial and scientific education. Some details upon these points will be given later, but it is appropriate to say here that this progress increases the cost of education, which has already risen to sixty per cent. more than the tuition fee, and that by so much all students of the Institute are assisted by the gifts in land and money of the general government, the State, and private individuals. It is apparent, therefore, that the accession of a large number of students in consequence of scholarship endowments makes necessary a large increase of income from unrestricted funds to meet the added charge. The eventual destination of all funds is similar to that of the scholarships, and the chief distinction lies in the restrictions imposed upon the use of the latter.

The Pierce Building has increased the floor space devoted to laboratories and recitation rooms by about 25 per cent.; the addition has proved very useful, and it is hoped that for some time to come no important changes will be necessary in the quarters allotted to the departments which have been moved.

It is worthy of note that the numerical increase of late years which has called for additional accommodations has been rather in the instructing staff then in the total number of students.

If our position in respect to the number of students were isolated, the fact would be discouraging, but this is not the case, for although the number of engineering schools in this and in other countries is rapidly increasing, the total number of their students has not increased, and in most cases has notably decreased. Taking the available statistics for the technical institutions of this country, we find the numbers increasing by 10 to 20 per cent. per annum till they reach a maximum in the year 1894–5, and since then a decrease of about 5 to 10 per cent. Our numbers have not fallen off in the same measure, but the increase has been much less rapid since 1893–4, and for the last five years there has been little change.

During the same period since 1894 nineteen additional instructors have been appointed in consequence of an advance, not in numbers, but in the character of the studies. This progress has been due in part to higher entrance requirements, but even more to the greater expansion which has been given to laboratory work. Experimental work of a high order exacts ever more and more a special preparation on the part of teachers and a greater subdivision of classes.

It is scarcely necessary to explain that this movement is in the direction of increased expense, and we find each year that the ratio between the cost of education and the tuition fee is continually growing on the debit side. Yet each year's experience confirms us in the stand that we have taken regarding technical education, and makes us believe more firmly in the ability of laboratory work for giving a professional man those qualities of originality, readiness, and fertility of resource in dealing with practical problems, which prove of immediate value when he enters upon an industrial career. It is often thought that these qualities are formed

later, but in many respects problems of school work, especially chosen for that purpose, are more fitted for developing and testing character than those of after life, and during school years a student can always feel assured of just ranking and friendly appreciation, while afterwards amid the rivalry of a business career he often has occasion to perceive that success is not always proportioned to unassuming merit.

It is unnecessary to present an argument against the view that theory can best be taught in the school and practice in the field, the office, or the workshop; because, even if this were true, an industrial school would not fulfil its mission by sending young theorists to be accepted or rejected after trial in the office or manufactory. It is our business to test the capacity of young men on the practical as well as the theoretical side, and to make our diploma as far as possible a guarantee of fitness to enter immediately on a career of professional usefulness.

Nothing is harder to predict, and nothing is easier to test, than the capacity of a young man for observation, experiment, and original work. We are obliged to reject many of those who wish to pursue technical studies in our school, and experience shows that the necessary qualities are exceptional rather than common in the student of good ability who comes from preparatory schools to college. Whether a different scheme of preparatory studies would give widely different results is an interesting but unsolved problem. A student does not become a skilled mechanic in our workshops, nor does he often make original investigations of great value in our laboratories, but he is given an opportunity to show what he may hope to do in after life, and we often have the satisfaction of finding that education by observation and experiment is capable of developing faculties which would not otherwise be called into exercise.

The progress in the direction indicated should be continued, and as a next step it is earnestly desired that means shall be found to enlarge the sphere of usefulness of the de-

partments of industrial chemistry and of electrical engineering and physics. Museum rooms for the exhibition of our valuable collection of products, of apparatus, and of models would be of use to the school and of interest to the public. Teaching and entertainment by evening lectures could be still further extended were a suitable building and fund for maintenance provided. Increased laboratory accommodation for machinery in motion and for electrical experiments would be of use not only to these departments, but also to the whole school, and the manner of such usefulness is strikingly set forth by the details of the report from the department of electrical engineering and physics. During last year seven hundred and ninety-two students pursued leading branches of study in this department, and the report shows how these studies form essential features of almost every course given at the Institute.

It is believed that the true policy of the Institute for the present is to turn our attention chiefly to raising the standard of instruction and providing better and larger accommodations in anticipation of having these improvements followed by an accession of the numbers who will come to us for professional education. All the information which we can collect regarding the demand for highly trained scientific professional men leads us to think that it is increasing, and where one such man enters upon the management of an enterprise which before was in untrained hands the results soon lead to calling for more men to build up a scientific staff. In all the branches of manufacturing and engineering business and in architecture the same tendency is now manifest which has long existed regarding the legal and medical professions: a tendency to confide to trained hands business which was formerly done by every one without special preparation.

Some details regarding the new building may be of interest to the Corporation. The Executive Committee voted to give it the name of Henry L. Pierce, in commemoration of his munificent bequest.

It adjoins the former Architectural Building on Trinity place, and the façade continues the design of that building, gaining in dignity by increased dimensions. It was erected according to the plans and under the supervision of Professor Homer as architect, and Professor Woodbridge for heating and ventilation. Professor Lawrence was given charge of the calculations for the iron structure, and was greatly aided by the counsels of Professors Swain and Lanza. Professor Puffer made a careful study of the electric lighting system. Professor Miller undertook the supervision of the construction of boilers and machinery, and devoted much time to the superintendence of this work.

The erection of the Henry L. Pierce Building nearly completes the occupation of two sides of the lot of land on Trinity Place.

The new building is fireproof, and contains many modern improvements, some of them novel, in the equipment of the biological and industrial chemical laboratories. The architectural drawing rooms and some others are supplied with a new system of incandescent lighting by reflection from the ceiling, which is founded upon experiments made by Professor Puffer in the physical laboratory, and will, it is hoped, be especially well adapted to the trying work of architectural and mechanical drawing. Actual tests were made by draughtsmen, and two oculists kindly gave their advice.

The Pierce Building meets the call for more space so urgently made by several departments in late reports. The basement story of the old Architectural Building and two-thirds of the new one have been devoted to heavy machinery of the Mechanical Engineering Department. The remaining third of the basement has been arranged for the lunch room, which is removed from the Rogers Building to make room for the expansion of the Mining Department. The Margaret Cheney room, formerly in the Walker Building, has been given more space on the second floor of the Pierce Building, and the

Geological Department has been removed to this floor from the Rogers Building. The third floor is chiefly occupied by the Biological Department, which had long outgrown its quarters in the Rogers Building. The remainder of the Pierce Building, besides some general recitation rooms, is occupied by the Architectural Department and the industrial chemical laboratories. Their needs have been studied with care, and the special reports of these departments will speak of features of the installation which are particularly worthy of attention.

The engine-house has been enlarged, and provision has been made for all the boilers and machinery which will in the future be required for warming and lighting the series of buildings which may be placed upon the land in Clarendon street now owned by the Institute. Two additional boilers, together with engines and dynamos of 250 horse-power, have been put in this summer for the use of the present buildings. It is good economy to join the warming and lighting appliances, and a notable saving in running expense can be made in that way, but the expenditure of capital upon the purchase of the plant is very large and forms a considerable percentage of the cost of a modern building. The upper story of the boiler house and machinery building, with a good light from above, forms an excellent modelling room for the Architectural Department.

The removal of the Biological and Geological Departments from the Rogers Building has made it possible to meet the want, long felt, of a suitable library for general purposes, and a reading room which can be kept open at all times for the use of students. A fine room occupying the whole of the north side of the Rogers Building has been fitted up for these purposes, and the English Department with its library occupies adjacent rooms. Considerable enlargements of the Secretary's and Bursar's rooms have been made, and Huntington Hall has been repainted and upholstered.

On the twenty-eighth of April a fire occurred in the ceiling

of the life class room of the Architectural Building, and much damage was done to the upper stories of that and of the Engineering Building. The material loss was covered by insurance, but such an accident to the appliances of our crowded buildings was a serious interruption to the work of the school. Energy and good will on the part of teachers and students soon extemporized means for resuming the greater part of the exercises, and fortunately the rooms burned contained no valuable machinery or apparatus. The irreparable disaster of damage to the architectural and engineering libraries was averted by the quick removal of the books and plates by the assistant librarians, instructors, and students, who neglected personal property in the drawing rooms to save the library. The government of the Institute has reimbursed private losses, since they were only in small part covered by the insurance.

The President of the Worcester Polytechnic Institute made a kindly offer of use of rooms, but it was not necessary to avail ourselves of it.

Plans of the Pierce Building and of the ground floor of the Engineering Buildings devoted to Mechanical Engineering are to be found at the end of this report.

The members of the Corporation, whose loss by death has been referred to, are Frederic W. Lincoln and John M. Forbes.

Mayor Lincoln was a charter member of the Corporation. His services began in 1861, and have lasted thirty-seven years, until the date of his death, Sept. 13, 1898. He was at various times a member of the following standing committees: the Society of Arts, the Museum of Industrial Arts, the School of Industrial Science, the Museum of Fine Arts, the Departments of Modern Languages, of Literature, History, and Political Economy, and also a member of nearly all the special committees charged with transacting the current business of the Corporation. He never regarded his duties as perfunctory, but was always present when possible, and ready

to place at the service of the Institute his sound judgment and great experience with men and public affairs. His long connection with our body will always be held in affectionate remembrance.

The death of Mr. Forbes has followed closely upon that of his son, and we have lost the powerful support of men who were leaders in the community. It is proper to speak here only of the points in Mr. Forbes' varied and successful career which touch upon the work of this Corporation, although we had reason to think that the wide sphere of his remarkable activity enhanced his usefulness to our Institute. His gifts have been large and timely, beginning in 1864 and continuing till 1894. President Rogers was in close relations with him from early days, and regarded him as a devoted friend and benefactor of the Institute. He was a member of our finance committee from 1866 till the time of his resignation in 1892, and it is needless to recall that this period was one of difficulty and financial embarrassment, when the duties of the committee were onerous. We look back with gratitude upon the services rendered by his liberality and by his financial talent.

Since I made my last report two important negotiations have taken place which are interesting from the nature of the questions involved, although they have not led to material results. One was with Harvard University, and the other with the United States Naval Department.

A letter was addressed from the Corporation of Harvard College to the Chairman of our Executive Committee asking for a conference. A committee of five was chosen at a meeting of our Corporation, and they held conferences with two members of the Harvard Corporation during the summer and autumn of last year. Your committee reported results to you at your stated meeting, March 9, 1898, and I will briefly recapitulate the substance of this report. The question under discussion was the possibility of avoiding a duplication of courses of instruction in industrial science in the

two neighboring institutions. The desirability of this end was recognized by both committees, and finally the terms of a proposed agreement were signed by all the members in conference, with the understanding that they would be submitted to the Corporation of Harvard College, as a first step toward further action.

The proposal for agreement provided for the transfer to the Institute of Technology of the courses in Civil, Electrical, Mechanical, and Mining Engineering, Metallurgy, and Architecture, now given at Harvard, as well as the use of the income from certain funds destined to the support of these courses. It was provided that the five Fellows of Harvard College should have a place among the fifty members of the Corporation of the Institute, and that two of them should be added to the present seven members of its Executive Committee, making a committee of nine. The presence on the governing board of the Institute of the above-named Fellows of Harvard College was in consequence of the use of funds belonging to the University, and of the alliance of the two bodies for the purpose of technical education. No further change in the form of government, and no changes of title or of independence of action on the part of the Institute were agreed to by the joint committee.

It is impossible to give here the details of a long and friendly discussion in which the end held in view was the advancement of education and the diminution of undue rivalry; but in order to understand the eventual failure to carry out an agreement it is necessary to say that the University Committee put forward the view that the charge of technical studies properly belongs with a university, and that a union, however slight it might be, between the University and the Institute, was desirable. The Institute Committee insisted upon the absolute independence of its government, and believed that condition to be most favorable to the free development of studies in a school of applied science. Our committee also called attention to the local situation, which

renders it unnecessary to duplicate in Cambridge studies that have been long established at Boston, and we believe that this view should receive due consideration, even although under other circumstances it may be the mission of a university to direct schools of engineering and allied professions.

The proposal for agreement signed by the Conference Committee was returned with the assent of the Harvard Corporation, but accompanied by conditions which modified its character, and which looked in the end to the establishment of a closer union. The Institute Committee were unable to see the possibility of making a promise regarding the future, and it will be remembered that they reported to the Corporation at the meeting of March 9 that no decision requiring action had been reached. Their report concludes with the following words:

"Although the result has disappointed our expectations, we still feel convinced that as friends and earnest promoters of instruction we can so direct the course of our respective institutions that they shall mutually help one another and avoid duplication of work.

"It is possible that such a result may be better attained by a friendly interpretation of our common purpose than by any attempt at a formal agreement.

"Your committee are encouraged in this hope by the very friendly acknowledgment of their reply to the Corporation of Harvard, which reads:

"'At a meeting of the President and Fellows of Harvard College, in Boston, January 31, 1898, a communication from the Committee of Conference on the part of the Massachusetts Institute of Technology was received and placed on file.

"'Voted to send the following communication to the committee:

"'The President and Fellows regret that the alliance with the Massachusetts Institute of Technology, proposed by them in a communication dated April 12, 1897, has failed.

"'The President and Fellows cordially recognize the friendly

spirit of the letter of the Committee of Conference of January 10, 1898, and will at any time meet the authorities of the Massachusetts Institute of Technology in consultation, for the purpose of avoiding unnecessary duplication of instruction.' "

The second matter upon which I have to report should not properly be called a negotiation. The initial action by the Institute was taken upon receipt, July 26, of a letter from an officer of the United States Navy, stating that the Secretary of the Navy had under favorable consideration a plan for educating the naval constructors at the Institute, and a desire was expressed for a consultation on the subject. Professor Peabody took a very active part in the matter, and views were interchanged regarding the appropriate studies for a three years' course in Naval Construction, and particularly the building of warships, to be taken by certain graduates from the Naval Academy at Annapolis. The next step followed upon receipt of a letter, dated August 17, from the Chief Naval Constructor, Commodore Hichborn, stating that he was instructed by the Secretary of the Navy to ask the Institute to submit for his consideration a scheme for the technical education of naval cadets assigned to the Corps of Naval Constructors. The immediate presentation was requested of a draft of a course which we would recommend for this object, and which could be at once begun at the Institute of Technology. The question was considered by the Faculty, and, after some further consultation with members of the Board of Naval Constructors, a programme of studies was sent to Commodore Hichborn early in September. Captain Dickens, of the Board of Navigation, was ordered to visit the Institute September 20. He saw the Secretary and Professor Peabody. As it was in vacation, and no notice was given of his coming, the other members of the Faculty were absent, and the models and appliances for the course in Naval Architecture were packed for removal to the new building. Captain Dickens reported September

22 to the Naval Department, and portions of the report appeared in the newspapers September 30. I was only able to learn from the Naval Department on October 29 whether the citations from the report were correct. Certain misconceptions and the following extraordinary passage in the report led me at first to think that the newspaper version was incorrect, but the copy sent me by the Naval Department shows that the newspapers were well informed. The passage alluded to states that "there is no method by which students can be kept up to their work by any means of discipline at the disposal of the Institute." The writer of the report, after stating what he understands to be the views and practice of the Institute regarding the course in Naval Architecture, advises the government to establish a post-graduate course at Annapolis. I have since been informed that the Naval Department has deferred a final decision upon this matter, and that meanwhile the post-graduate studies in Naval Architecture will be carried on at Annapolis.

It is interesting to note that here, as in the negotiations with Harvard University, we take the ground that any branch of technical education is intimately associated with the general scheme of work in an industrial school, and that the traditions and plans of education of such a school are necessarily of slow growth, and that the best conditions for such growth are favored by the independent existence of a governing and educational staff devoting their entire attention to a special educational problem. In the instance before us we contrast a plan to form at Annapolis classes of three to five graduates, and for the detail of a certain number of officers to give a course of naval construction, which shall be added as a post-graduate study to a naval academy, with the programme which we offered to the Naval Department. The latter treats the question as a part of a general engineering problem, which can only be solved to the best advantage in a large engineering school. Our proposed plan of studies brings the students under twenty-five teachers,

each competent and interested in some special branch, and it may be added that in the work accessory to their strictly professional studies the small class of naval constructors would have found themselves in contact with students, as well as with teachers, who were looking to the professional application of the branches which for naval construction are accessory, such as electrical or sanitary engineering, etc. Each class of students in a large school contains a group of young men who intend to make the study in question their life's work, and who inspire the others with some share of the spirit of intelligent application which springs from a foresight of the advantage that a thorough knowledge of the study will afterwards bring in their professional work. Much of the success of a technical school depends upon the propagation of this spirit.

American Association for the Advancement of Science.

In the spring of 1897 the Corporation and the Faculty united with other colleges and learned societies in extending an invitation to the American Association for the Advancement of Science to hold its 50th anniversary meeting in Boston. This invitation was accepted and the meeting was held at the Institute, August 22 to 27, Professor Sedgwick being Chairman of the Local Committee of Arrangements and Professor Tyler Local Secretary. Although the reconstruction work in the Rogers Building could not be completed before the time of the meeting, the work was so well advanced that all needful rooms were made available. The attendance was very large, and much cordial appreciation was shown of the courtesies extended to our visitors.

Omaha Exposition.

The exhibition made by the Institute was a partial one. We supplied photographic and other material for the use of

the United States Commissioner of Education in the collective exhibit of the land-grant colleges, and a distinct Institute exhibit was made in the mining building. The cordial cooperation of two of our graduates in Omaha, Mr. Earl W. Gannett of the class of 1889, and Mr. Arthur S. Rogers of the class of 1894, enabled us with a very small outlay to make an exhibit of value in the gallery of that building. Photographs and other material illustrating the work of the Mining Department were naturally made prominent, but were supplemented by architectural designs, and by a liberal supply of publications. At the close of the exposition the Institute was awarded a gold medal for its exhibit. It may be added that the exposition from an architectural standpoint was largely the work of Institute men, including the architects-in-chief, Messrs. Walker and Kimball, and several of their associates.

The Libraries.

The total number of accessions is 3,261. Of these, 1,197 were obtained by purchase, 703 by binding periodicals and books received in parts, and 1,361 by gift and exchange. After making deductions for books counted twice, for those lost, etc., the total net increase is found to be 2,696 volumes and 516 pamphlets, so that at the end of the period covered by this report the libraries of the Institute contained a total of 46,711 volumes and 14,121 pamphlets and maps.

The expenditures for the year on account of the libraries may be summarized as follows:

Books and binding	$3,783.34
Periodical account	1,466.28
Expense account	176.59
Total	$5,426.21

Details in regard to the increase in the several libraries, and the expenditures of the departments on this account, are given in the following table. The arrangement of the items in this table differs somewhat from that given in the table

of last year, on account of the transfer of the libraries of English Literature, Modern Languages, and Military Science to the General Library.

TABLE OF NET INCREASE, 1897–98, SHOWING COST OF SAME, AND TOTAL CONTENTS OF THE LIBRARIES OF THE INSTITUTE, SEPT. 30, 1898.

LIBRARIES.	NET INCREASE.		Cost Departments.	TOTAL CONTENTS.	
	Volumes.	Pamphlets.		Volumes.[1]	Pamphlets and Maps.[2]
General Library. General	207	173	$47.80	4,005	3,423
General Library. English Literature	99	1	145.91	2,372	37
General Library. Modern Languages	29	18	91.69	594	18
General Library. Military Science	38	6	32.90	136	6
Totals General Library	373	198	$318.30	7,107	3,484
Architecture	195	15	446.59	2,225	200
Biology	121	30	203.73	2,071	404
Chemistry	272	38	379.19	7,228	1,515
Engineering (C.E., M.E., & N.A.)	640	55	899.06	7,922	3,374
Geology	73	13	103.46	1,838	818
Mathematics	108	50	151.82	.648	163
Mining	151	18	151.29	2,054	341
Political Science. (Econ. & Hist.)	448	79	527.82	9,008	3,120
Physics	315	20	602.08	6,011	689
Margaret Cheney Room	.....	.....	.....	599	13
Totals	2,696	516	$3,783.34	46,711	14,121

The enumeration of pamphlets in this table does not fully represent the wealth of the libraries in that form of literature. In the Physical Library there is a large number of pamphlets, which were catalogued by the assistant in charge during the last year, but they do not appear in the table because they have not been entered in the record of accessions. Also in the Chemical Library there are many reports of state boards of health, bulletins of agricultural experiment stations, and

[1] Including volumes of collected pamphlets.
[2] Including pamphlets bound together in volumes.

the like, in pamphlet form, which require considerable attention from the Librarian, occupy space, and are of a certain amount of use, but which will not appear in the tables until they are collected together in volumes and bound.

Some of the data usually given to show the amount of work done in the Library may be presented in the form of a table as follows:

Number of orders given for the purchase of books	1,349
Number of order-slips found to be duplicates and returned to heads of departments	173
Number of these reordered	5
Foreign books received for inspection	139
Number of these purchased	60
Orders for binding and lettering	1,053
Cards added to the main catalogue	2,469
Total number of cards in the main catalogue	42,142
Books borrowed from the Chemical Library for home use	2,199

Unfortunately the Chemical Library is the only one in which a record has been kept of the use of the books. Here the proportion of borrowings to the total number of books is high, about 2:7, but it is probable that this would be found not to be much above the average of the other libraries. The system of suggestions for purchase is continued as heretofore, with good results. Every week the American, English, French, and German lists are read over, and any title which appears likely to be of interest to any department of the Institute is brought to the attention of the head professor by means of a "Suggestion for purchase." A large proportion of these have been accepted, but no record was kept of the number.

The clerical force of the Library has reached a state of efficiency never before realized, and the Librarian is enabled to do the work more effectively than heretofore. It has been said that two of the most important libraries of the Institute were seriously threatened by the fire in the Engineering Building, and one of them, the Architectural Library, would

have suffered very serious damage, if it had not been for the prompt work of the students in the building. We cannot give too much praise to these students, who showed such practical loyalty to the Institute, and to Miss Loring, assistant in charge of the library, who coolly stayed upon the scene and directed the work until every book had been removed to a place of safety.

The end of this year marks the beginning of a new epoch in the history of the Library. Heretofore the General Library was simply the office of the Librarian, and incidentally served as a study for first-year students, and a place to store odds and ends that could find no place in the departmental libraries. Now the General Library has been removed to the large room formerly occupied by the biological laboratory. The room has been entirely remodelled, decorated, furnished in mahogany, and provided with electric lights. Adjoining the library is an office, where the Librarian is provided for the first time with room adequate for the work that he has to do. The books and periodicals of the Departments of English Literature, Modern Languages, and Military Science have been added to the General Library, and it is hoped this library will become more widely useful to instructors as well as to students.

Mrs. Henry Draper continues to give the Institute the "Comptes-Rendus de l'Academie des Sciences de Paris." In like manner we are receiving through the generosity of Mrs. William B. Rogers, "Nature" and "Popular Science Monthly." Mrs. Rogers has also given us a number of volumes, including two volumes of Hall's "Palæontology of New York." Among the other gifts to the Library may be mentioned: "History of the Lowell Institute," from Mr. Augustus Lowell, nine volumes on fuels and combustion from Mr. Charles F. Allen, and sixty-one pamphlets and five volumes from Professor Runkle. Professor Gill, Professor Bates, Professor Noyes and Doctor Mulliken, Professor van Daell, Professors Bailey and Woods, Mrs. Richards and Miss Maria Elliott,

and Professor Wells have each presented the Institute with copies of their published writings.

SCHOLARSHIPS.

The work of the Scholarship Committee of the Faculty has continued to increase, and the demand on the part of needy and meritorious students has more than kept pace with the large increase in available resources. A further payment from the estate of the late Mrs. Dickinson has recently increased our principal by $40,000, but the full income of this amount is not available for the present year. The number of applicants for Institute scholarships up to the present time has been 127, while 127 submitted applications for the forty State scholarships. Sixty-eight of these made applications in both places, leaving the total number of applicants considered by the Faculty and the State Board of Education 186. Of these, 38 have received scholarships to the amount of full tuition; 86 others have received smaller amounts, averaging somewhat more than one hundred dollars each.

Last year a decision from the Attorney-General's office appeared to preclude the further division of State scholarships in halves. As such division had made it possible to assist a much larger number of applicants to the extent needful, representations were at once made to the Legislature, which led to the enactment of a supplementary act authorizing division for the future.

Attention was called in the last report to the fact that repayment had not been made to the desired extent by past beneficiaries of the Rogers Fund. In view of the fact that returned amounts become immediately available for use as income, it seemed especially important to the committee that some improvement should be effected. Notes were accordingly sent by the Chairman of the Alumni Committee to those persons whose indebtedness was of somewhat long standing, and more than $300 has been returned for the immediate use

of the Scholarship Committee. It is hoped that many such returns will be made in the future.

GRADUATE SCHOLARSHIPS.

The graduate scholars of the current year are Messrs. D. W. Edgerly, of the class of '98; W. T. Keough, of the class of '88; E. S. Manson, Jr., of the class of '97; G. P. Stevens, of the class of '98; and C.-E. A. Winslow, of the class of '98. Of these Messrs. Edgerly, Stevens, and Winslow are candidates for the Master's degree; Mr. Manson received that degree last year; Mr. Keough is taking special work in naval architecture. By the generosity of Mr. Augustus Hemenway, Mr. Winslow receives a scholarship of $400, and will be designated in the catalogue as Hemenway scholar.

FELLOWSHIPS.

The Swett fellowship is retained by Mr. William David Coolidge, of the class of 1895. Mr. Coolidge's work in Leipzig has been so successful that he has received an appointment as private assistant to Professor Drude for the current year.

Mr. Wendell, who had held the Savage fellowship for two years, not having renewed his application, the fellowship has been transferred to Mr. George K. Burgess, of the class of 1896, who has been for the last two years Assistant in Physics. Mr. Burgess is now engaged in advanced studies at Paris.

Mr. Herbert William Chamberlain, of the class of 1895, was also an applicant for a fellowship, and it was with much regret that the Faculty found itself unable to assist him. He has, however, in recognition of his attainments and the merit of his plans for work abroad, been appointed a Fellow without pecuniary aid, and Mr. Wendell's name has also been retained as an honorary Fellow. It is believed by the Faculty that advanced work by our graduates under the general

direction of the Faculty may well be recognized in this manner.

Military Science and Tactics.

Captain Bigelow was called to active service shortly before the expiration of the time of his detail, and I desire to express our regret at the termination of his connection with our Institute. We are indebted to his initiative for the excellent footing upon which the military instruction has been placed, and to his zeal, untiring interest, and good judgment as a member of the Faculty in conducting these studies in harmony with the general policy of the school. It was impossible, on account of a decision of the War Department, to secure the detail at present of an officer on the active list, nor did we succeed in obtaining the appointment of a retired officer of the regular army, but we have secured the services of Captain John Bordman, Jr., Battery A, 1st Massachusetts Heavy Artillery, who has been appointed military instructor for one year.

Captain Bordman entered service in 1888; held commission in Harvard Rifles and studied military science at Harvard University, from which he holds degrees of A.B., 1894, and LL.B., 1897. He specialized in American history, taking highest second-year honors, and honorable mention twice. He performed active service when his regiment was mustered into the United States volunteer army.

The instruction in military science and tactics has proved of immediate advantage to certain of our students during the last summer, when the volunteer army was mustered into service.

A long continued correspondence with alumni and with special students who have followed courses at the Institute has given us the names of seventy-five who were engaged in the military service of the United States during the recent war with Spain, but some names are still wanting.

The following lists commemorate the names of these men:

Members of undergraduate classes who entered the United States service:

Adams, H. H., '99, engineering work at Fort Warren.
Borden, Raymond D., 1902.
Bowditch, Ingersoll, 1900.
Boyle, John, Jr., 1901.
Dodge, Lyman E., 1901.
Hasbrouck, R., '99.
Hitchcock, Albert W., '99, 2d Massachusetts Regiment.
Kendall, Frederic M., 1900, Sergeant, 6th Massachusetts Volunteers.
Little, James L., Jr., 1900.
Miller, Stuart B., 1900.
Patch, Claude E., 1901, 6th Massachusetts Regiment, Acting Bugler.
Pierce, Reginald K., '99, Troop A, N.Y.
Robson, Edward R., 1900, coast defence.
Snelling, Howard, '99.
Stevens, F. B., 1900, coast duty with Cadets.
Taylor, Denzil H., '99, Company A, 6th Regiment.

Former students serving in the Regular Army during the war with Spain:

Borup, Henry D., '84. Graduate of West Point, Lieutenant, U.S.A.
Füger, Frederick W., '91. 1st Lieutenant, 13th U.S. Infantry.
Haines, John T., '85. 1st Lieutenant and Quartermaster, 5th Cavalry, U.S.A.
Lyle, David A., '84. Graduate of West Point, Captain, Inspector of Ordnance, U.S.A.
Osgood, Henry D. Private, U.S.A.
Ripley, Henry L., '73. Captain, 3d Cavalry.
Russell, Andrew H., '68. Graduate of West Point, Inspector of Ordnance.

Weston, John F., '85. Graduate of U.S. Artillery School, Brigadier General, U.S.A.

Former students serving in the Volunteer Army or Navy:

Alden, Charles H., Jr., '90. Corporal, Company D, 1st Corps Cadets, M.V.M.

Allen, William H., Jr., '97. 1st Corps Cadets, M.V.M.

Ames, Azel, '95. Captain, 1st Regiment, U.S. Volunteer Engineers.

Ames, Butler, '96. 1st Lieutenant, Light Battery A, until May, '98. Resigned to accept Adjutancy of 6th Massachusetts Regiment. Appointed Lieutenant-Colonel.

Appleton, Charles B., '84. At Camp Dewey, on the Provost Guard.

Atwood, Thomas C., '97. April, '98, Naval Brigade, M.V.M. June 16, '98, enlisted U.S. Navy. Sept. 5, '98, honorably discharged from Navy. Served on gunboat "Inca," as gunner's mate.

Bemis, Albert F., '93. Company A, 1st Corps Cadets, M.V.M.

Borden, Charles N., '89. Sept. 30, '92, Naval Brigade, M.V.M. Nov. 1, '92, appointed Petty Officer. March 9, '98, received commission as Ensign, U.S.N. Sept. 16, '98, received honorable discharge from Navy. Now Ensign in Naval Brigade, U.S.N.

Coburn, Arthur S., '95. May 16, '98, machinist at Boston Navy Yard, detailed to U.S.S. "Southery."

Collins, Bertrand R. T., '88. May 24, '98, Ensign in U.S. Navy. June 2 to September 22, Watch and Division Officer, U.S.S. "Scorpion." October 22, honorable discharge.

Conant, Francis M., '96. 142d Separate Company N. G., N.Y.

Dana, Leslie, '96. Light Battery A, 1st Missouri Volunteers. Detached duty on the U.S.S. "Gloucester."

Daniell, Jere R., '97. Assistant Engineer with rank of Ensign, U.S. Navy.

DuBois, Barron P., '92. Past Assistant Paymaster, U.S.S. "Bennington."

Feland, Logan, '92, Captain, Company K, 3rd Regiment, Kentucky Volunteers.

Ferguson, John N., '94. March, '96, Massachusetts Naval Brigade.

Foster, Sumner H., '95. Captain.

Hammond, Charles F., '91. Chief Master-at-Arms, U.S.S. "Yosemite," acting May 19 to August 22, Michigan Naval Militia. August 22, honorably discharged.

Hayden, Charles, '90. 1st Corps Cadets, M.V.M.

Hewett, Joseph, '96. 1st Lieutenant, 2d Co., M.P.M.

Holton, Edward C., '88. Sergeant, Troop C, 1st Ohio Volunteer Cavalry.

Howard, Sheldon L., '98. 2d Lieutenant, 5th Massachusetts Infantry, U.S. Volunteers.

Howe, J. Wilder, '93. 2d Lieutenant, 2d Regiment of Engineers, U.S. Volunteers.

Hubbard, Chester D., '97. 1st-class Sergeant, 1st U.S. Volunteer Signal Corps.

Hunt, Alfred E., '76. Captain of Light Artillery, U.S. Volunteer Service from Pennsylvania. In camp at Mt. Gretna, Chickamauga, and Porto Rico. Service at Santiago.

Kent, William A., '97. May 15, Sergeant 1st Volunteers, transferred to 3d U.S. Volunteer Engineers. June 29, Sergeant-Major. September 12, 2d Lieutenant.

Kotzschmar, Hermann, '95. Engineer, U.S. Navy.

Lansingh, Van Rensselaer, '98. July 21, '98, U.S. Volunteer Engineers, 2d Regiment, 2d Battery, Company E, at Chicago.

Lenfest, Bertram A., '90. Company A, 6th Regiment, M.V.M.

Loomis, Henry M., '97. 142 Separate Company, N. G., N.Y.

MacClure, Colbert A., '94. June, '98, 2d Lieutenant, Company D, 17th Regiment, National Guards of Pennsylvania.

MacRae, Donald, '85. Captain of Company K, 2d Regiment, North Carolina Volunteers.

Messenger, William H., '92. Assistant Engineer, rank of Ensign, U.S.S. "Cincinnati."

Morris, Charles, Jr., '96. June, '98, U. S. Navy, as Assistant-Paymaster, U.S.S. " Hist."

Pierce, Edward L., Jr., '86. 2d Lieutenant, 1st U.S. Volunteer Engineers.

Pierce, Josiah, Jr., '86. Colonel on General Grant's Staff in Porto Rico, engineer's office.

Pope, Charles H., Jr., '97. Private.

Sears, Henry D., '87. Lieutenant in command of Company E, Massachusetts Naval Brigade.

Sears, Mortimer A., '96. May 1, '97, enlisted Denver City Troop N.G.C.

Smalley, F. N., '96, Hospital Corps, U.S.A., Manila.

Sprague, Timothy W., '87, Company B, 1st Corps Cadets.

Stearns, Frederic B., '98. With Cadets.

Stearns, Walter M., '96. 1st Corps Cadets M.V.M.

Strickland, William R., '98. May 14, '98, Assistant Engineer, U.S. Navy, relative rank of Ensign. Assigned to U.S.S. " Bennington."

Swift, William E., '95. July 20, '98, 2d Lieutenant, 20th Company Provisional Militia of Massachusetts. Aug. 3, '98, received commission.

Taylor, Edward M., '98. 1st Lieutenant, U.S. Volunteer Engineers.

Thompson, Frederic, '98. Oct. 5, '98, appointed Civil Engineer U.S. Navy, rank of Lieutenant (junior grade).

Tillinghast, Charles F., '95. April 28, '98, U.S. Volunteer Service, Rhode Island Regiment. May 10, '98, appointed Captain, Company A, 1st Rhode Island U.S. Volunteer Infantry.

Vielé, Maurice A., '86. Captain, 1st U.S. Volunteer Engineers.

Wells, Edward C., '92. Past Assistant Engineer, 2d Battalion, Naval Militia of Illinois.

Wood, Kenneth F., '94. Warrant officer with rank of Sergeant. Member of Hospital Corps Brigade of Rhode Island.

Changes in the Faculty and the Corps of Instruction.

Dr. H. O. Hofman has been appointed Professor of Metallurgy. He was made Associate Professor in 1891, after a previous connection with the Institute commencing in 1885. Born in Heidelberg, and trained in scientific studies in that university, he entered the royal Prussian School of Mines, and was graduated 1877 as mining engineer and metallurgist, and entered the government service at the Lautenthal Smelting Works in the Harz Mountains. In 1881 Dr. Hofman came to America and engaged in metallurgical work, being employed in Pennsylvania, Missouri, Kansas, Colorado, and Mexico. His thorough acquaintance with European and American metallurgical processes has been of great value in his teaching, and his text-book, referred to elsewhere, makes him a recognized authority on these subjects.

Dr. Henry P. Talbot has been appointed Professor of Analytical Chemistry. He graduated at the Institute in 1885, and studied in Germany for two years. Since that time he has been continuously connected with the chemical department of the Institute, and after the departure of Dr. Drown he performed with great fidelity and good judgment a large share of administrative work of the chemical departments. He has charge in the laboratory and the lecture room of the large classes in analytical chemistry.

Assistant Professor Bartlett has been appointed Associate Professor of Mathematics, having served the Institute with marked success, not only as a teacher of mathematics, but in other directions, since his graduation.

Mr. Henry G. Pearson has been appointed Assistant Professor of English. He received his A.B. degree at Harvard in 1893, and was appointed Instructor in English in the same year. The Department of English has been so much strengthened in recent years that it is now able to coöperate effectively in criticism of written work of students in other departments.

Mr. James Swan, '91, after spending the summer vacation in government service at Newport News, finally resigned his instructorship in Naval Architecture to enter the employ of the Newport News Shipbuilding Company. Mr. Swan's work in the department was taken by Mr. Carl H. Clark, '95, who was transferred from the Department of Mechanical Engineering.

The following assistants have terminated their connection with the Institute:

Frederic W. Howe, B.S.,
George K. Burgess, S.B.,
Leonard H. Goodhue, S.B.,
Fred E. Busby, S.B.,
Minor S. Jameson, S.B.,
William L. Root, S.B.,
Charles N. Haskins, S.B.,
Nathan Hayward, A.B., S.B.,
Herman W. Marshall, S.B.,
Minot A. Bridgham,
Ira G. Studley,
William F. Hyde.

The following new assistants have been appointed:

Charles B. Breed, S.B., in Civil Engineering.
Joseph G. Coffin, S.B., in Physics.
William T. Hall, S.B., in Analytical Chemistry.
George M. Holman, M.D., in Biology.
Areli H. Jacoby, S.B., in Industrial Chemistry.
Carleton S. Koch, S.B., in Mining Engineering.
Alice G. Loring, in Architecture.
Joseph C. Riley, S.B., in Mechanical Engineering.
Eugene W. Rutherford, S.B., in Mechanical Engineering.
Lewis J. Seidensticker, S.B., in Oil and Gas Analysis.
Harrison W. Smith, A.B., S.B., in Physics.
Maurice De K. Thompson, S.B., in Physics.
James Francis Leary, in Forging.
Joseph Albert Frizzell, in Woodwork.
Frank Cushman, Jr., in Machine Tool Work.

Entrance Requirements.

The addition of an elective subject to our previous entrance requirements was announced in the last catalogue, and has

gone into effect this year. The information obtained through the teachers' certificates has been of much value, and the laboratory note-books have shown that work of high quality in physics and chemistry is done in not a few of the secondary schools. Next year solid geometry becomes an absolute requirement for admission, instead of an alternative, as now, with advanced algebra. The Faculty are of opinion that all secondary schools preparing students for the Institute should be able to teach solid geometry, and it is in general better for students to prepare in this subject than in advanced algebra. It will still be possible, however, for the stronger schools to teach both subjects, as they have done heretofore.

Departmental Reports.

Mathematical Department. — No radical changes have occurred in the department during the past year. The number of sections has remained unchanged, and with the present constancy of the total number of students, no increase is likely to be needful in the near future. The department has shared to some extent in the Institute expansion, gaining the use of Room 20 of the Rogers Building for its library and collection of models. Delays have occurred in the preparation of cases for this room, but it will form when finished a commodious and accessible room for instructors and advanced students. A special appropriation has been made for the purchase of needful books of reference for the library. Professor Woods is at present giving an advanced course at Harvard, the occasion being the absence for the year of Professor Peirce.

The Department of Modern Languages has been called upon this year to take its share in the work of preparation for the industrial expansion which is expected to result from the conquest of colonial possessions.

The class in Spanish has mounted from eight to fifty students. It is probable that this large increase springs from temporary enthusiasm, but it is certain that we shall be

required to provide more than hitherto for the linguistic education of our graduates who seek occupation in foreign lands. If this movement takes place, it will be a new one, for the addresses of the graduates in 1896 and in 1897 show only two names of students now residing abroad, and one of these is an alien.

Courses I. and XI., Civil and Sanitary Engineering. — No changes have been made in the courses of study during the past year. The occupation of part of the new building has given a much needed increase of space in this department, and there is now ample accommodation for a number of years.

The greater part of the upper floor of the Engineering Building, which was formerly occupied by the second and third year drawing rooms, is now devoted to the second year alone, the partition, which was partially destroyed by fire, having been removed. This room will accommodate over one hundred and fifty desks, and will provide for considerable growth. The upper floor in the former Architectural Building is now occupied as the third-year drawing room, and will accommodate from sixty to eighty students. The floor below, of the same size, is occupied as the fourth-year drawing room. The old fourth-year drawing room has been given up partly to private offices which had to be moved on account of the extension of the library, and the remainder is used as a model room and museum in which the various instruments, models, and specimens of the department are kept in cases where they will be easily accessible, and where they may at the same time prove of interest to visitors. More ample space, together with the construction of the geodetic observatory, enables the work of the Civil Engineering Department to be carried on to much better advantage than ever before.

The geodetic observatory, to which reference was made in my last report, was completed during the last spring. It is located in the Middlesex Fells, upon a site which is very favorable for the observations which are there to be conducted. The thanks of the Corporation are due, and have been expressed, to the Metropolitan Park Commissioners for

permission to erect the building in this location. The observatory is a stone building fifteen feet square, and has already been equipped with a number of instruments, including a break circuit chronograph, a sidereal chronometer, a transit instrument with micrometer eyepiece, and various smaller instruments. The magnetometer, owned by the Physical Department, will also be used here. A dip circle has already been ordered, and during the present year the observatory will be further equipped with a pendulum apparatus for measuring the relative force of gravity and with a large altazimuth instrument. With this equipment, the Civil Engineering Department will be able to offer superior advantages for the study of geodesy.

The property of the department has been further increased during the year by the addition of a large number of photographs and slides, and during the coming year it is expected to make this collection very complete and valuable.

The extension of the engineering laboratory into the basement of the Architectural Building affords the much-needed increase of room in the hydraulic laboratory and pit, to which reference was made in my last report.

Various excursions have been made during the past year to works of interest in the neighborhood of Boston, and thanks are again due to President Lucius Tuttle, of the Boston & Maine Railroad; General Manager W. H. Barnes, of the Boston & Albany Railroad; General Passenger Agent A. C. Kendall, of the New York, New Haven & Hartford R.R.; Superintendent of Streets B. W. Wells; Deputy Superintendent C. R. Cutter; and various other gentlemen, for courtesies extended in connection with these excursions and with the general work of the department.

Summer School of the Civil Engineering Department. — The summer school for field-work in the Civil Engineering Department was held during the month of June at Lancaster, Mass., a new location for this work. This was the eleventh summer school of this department. Sixteen stu-

dents were in attendance. Instruction was given by Professors Burton, Porter, Robbins, and Barton, assisted by Mr. McKibben and Mr. Hosmer of the instructing staff, and by Mr. H. R. Thayer of the class of '98. The work was continued during nearly four weeks. The usual practice was given in topographical field work, and in triangulation and base-line measurements, and gaugings were made of the flow of water in the two branches of the Nashua River, and also in the mill flumes in Lowell. Under the direction of Professor Barton, geological field work was also carried on. A meteorological station was established on Mt. Wachusett, and the regular records of the weather bureau were there taken. Observations were also made for time and latitude. Practice was given in signalling with the heliotrope, and observations were made on atmospheric refraction.

Course II., Mechanical Engineering. — For the last two or three years the engineering laboratories have been gradually becoming more and more crowded, until they have reached such a condition that a part of the apparatus in our possession could not be utilized, and some could not be used to the best advantage. This matter has been remedied by the erection of the Pierce Building; there has been added to the engineering laboratories the basement of the former Architectural Building and also one-half the basement of the Pierce Building, making their total floor space about 21,000 square feet.

The drawing-room No. 20, on the second floor, is now occupied by second and third year students, 124 in the first term and 171 in the second term. The drawing-room No. 30, on the third floor, is occupied by 117 third and fourth year students. Two hundred and eighty-five drawing tables are now used, and their number could be increased to 315, and a somewhat larger number of students could be accommodated because in the second year two can use one desk.

The laboratory of applied mechanics admits of experimental work with machines and apparatus for 135 students, with some margin for expansion.

The other portions of the engineering laboratories have space for about 300 students. The largest number which has yet worked in them is 243.

In the basement of the Pierce Building has been placed a McIntosh and Seymour 11-inch and 19-inch by 15-inch tandem compound engine, provided with a surface condenser and an air pump, all suitably arranged for purposes of experiment. The main drive wheels are rope wheels, and the power is taken from this engine to the main line of shafting by a rope drive. A Prony brake of 100-horse-power capacity is also placed in this laboratory. This brake was already in possession of the Institute, but could not be used for lack of room.

The 36-horse-power Otto gas engine and the rotary pump are on foundations in this room, and can now be operated at their full capacity for purposes of experiment. There is a large cistern for water, which is connected by a pipe with the cistern in the Engineering Building, thus furnishing a larger cistern capacity for water for the hydraulic experiments. The boiler-house has been enlarged, and two new horizontal tubular boilers have been added, these being fitted with Hawley down-draught furnaces. This furnishes additional opportunities for boiler testing.

Besides the improvements in the engineering laboratories, there has been added to the drawing-room space the second floor of the former Architectural Building, and a new drawing-room has been set apart for the Department of Naval Architecture, thus relieving our drawing-rooms from their crowded condition.

A new circular of the department has been issued, describing the equipment as it now exists, and containing plans of the laboratories. The following table, taken from this circular, shows the present occupations of all the living graduates from '68 through '97. It is interesting to follow the careers of those whom we have undertaken to train for industrial pursuits, and to find that ninety per cent. are now making a direct use of that training.

Professor Peabody has issued this autumn a revised addition of his "Thermodynamics of the Steam Engine." This standard text-book has undergone a thorough revision since the date of the last edition, 1889, and includes the last experimental work on the subject.

OCCUPATIONS OF THE LIVING GRADUATES IN MECHANICAL ENGINEERING, 1868–97.

Railroads, including brakes and signals	29	Lawyers and patent solicitors	6
Textile industries and machinery	30	Building materials	4
Steam-engine and steam-pump works	17	Cordage works	2
Steel and iron works	14	Contracting engineers	2
General machinery	27	Photographic materials	5
Electrical works	22	Testing laboratory	1
Ship and marine engine works	16	Astronomy and meteorology	2
Experts and consulting engineers	27	Editor	2
Experts' assistants	11	Chemist	1
Special machinery and manufactures	69	Architect	1
Teachers	36	Military	3
Mill insurance	7	Surveyor and landscape gardener,	4
Refrigerating machinery	4	Doctors	2
Paper making	4	Artist	1
Gas works	2	Farmer	1
Water and sewerage	5	In business	27
		Students	1
		No record	4
			389

The publication of the results of tests in the Technology Quarterly has been continued: No. IX. issued March, 1898, and No. X., September, 1898.

APPLIED MECHANICS. — The basement of the former Architectural Building has been added to the laboratory of applied mechanics, and in this room have been placed the transverse testing machine of 18,000 pounds capacity, the machine for testing sliding position, and the machine for testing the wear of brake shoes and wheel tires, all of which were in the other part of the laboratory, where they had not sufficient room. The two experimental governors have also been placed here.

The power is transmitted to this room from the other part of the engineering laboratories by a rope drive presented to the Institute by the Dodge Manufacturing Company.

There has been built, out of doors, a kiln for drying lumber, to allow of the study of the effect of different percentages of moisture upon full-size timber beams and columns.

SHOPWORK. — The total number of students taking shopwork is 231 (last year it was 210). Many of these take more than one course, and they are divided among the different shop departments as follows:

CARPENTRY AND WOOD TURNING,	
Courses II., VI., X., and Special Class	103
FORGING,	
Courses II., XIII., and Special Class	89
CHIPPING AND FILING,	
Courses II., XIII., and Special Class	54
MACHINE TOOL WORK,	
Courses II., XIII.	34
METAL TURNING,	
Course VI.	39
PIPING,	
Course XI.	2
	321
Students taking more than one course and counted two or more times	90
	231

The change of the shop entrance to the large central door in the front of the workshops, located on the driveway leading from Garrison street, has resulted in extensive improvements and enlargements. This entrance, which replaces the three doors previously used, now gives direct and convenient access to all of the shop departments. At the right of this main entrance a large lavatory (30 ft. × 40 ft.) has been fitted up with suitable sinks and 204 lockers. From the lavatory the students may go directly to the different departments, a partitioned passage through the carpenter shop leading to the forge shop. There can now be no interference with class work by students passing in or

out of the shops. To make room for the lavatory, the tool-room of the machine shop was moved to the west, where it is increased in size about one-third. It is now 40 ft. × 12 ft., and is more conveniently located. West of the tool room, and in the space formerly taken up in part by the entrance to the machine shop, an "instruction-room" for chipping and filing and machine-tool work has been fitted up with seats, forming an amphitheatre about an engine-lathe, speed-lathe, and chipping and filing bench. This, it is believed, will prove a great convenience and assistance in giving instruction. In the rear of this room an office has been fitted up for the instructor.

The removal of the machine-shop lavatory has made available a space about 10 ft. × 40 ft. This may be advantageously used for new machinery, which it is hoped we shall have before long. A new office has been constructed for the instructor in forging, without loss of shop room, and it has been found a great convenience when compared with previous arrangements.

Course III., Mining and Metallurgy. — This department has relinquished Rooms 36 and 37 on the third floor of the Rogers Building and has received in exchange the space recently occupied by the lunch-room. This change, together with the removal of the blowpipe work to the Pierce Building, has permitted the consolidation of the instruction to great advantage. The lectures are now all given in one room, with charts and specimens always at hand for illustration, and a much needed laboratory for mining and metallurgical tests on a small scale has been installed with desks for twenty students.

The assaying laboratory has been enlarged and now has desks for seventy-six students.

The other laboratories are arranged for the instruction of classes in sections of the following numbers:

Assaying laboratory	15
Smelting laboratory	10
Ore-dressing laboratory	10

The lavatory has lockers for one hundred students.

The room for assay supplies has been enlarged to meet the increasing demand.

Two new offices have been partitioned off, one for Professor Lodge and one for the assistants.

The collections of ores and metallurgical products have all been assembled in one room to be used as a museum, and are now being thoroughly arranged and labelled.

The Mining and Metallurgical Laboratory has been supplied with a new Root blower of greater capacity than that formerly used; with a new crucible furnace for larger crucibles and higher heats than that which it replaces; with a new chlorinating barrel for gas chlorination of gold ores; with a set of Devereux slag pots for the blast furnace; with an electric motor which will drive all the machinery in place of the engine; with a new Harz jig for concentrating ores. The crushing rolls have been newly mounted with Gates feeder and adjustments for graded crushing.

Professor Richards' book on ore dressing is nearly completed. During the year he has contributed an article on ore dressing to the Mineral Industry.

The new edition of Professor Hofman's work on lead has passed through the press and is just now coming out. This book contains a complete treatment of the processes used in America and of foreign methods so far as they interest our metallurgists, and it is a most important authority upon the subject.

Professor Hofman has written two papers on testing clays, one on coking in by-product ovens, and has contributed an article on "Lead" to the Mineral Industry.

Professor Lodge is preparing a new edition of his "Lithographic Notes on Assaying."

SUMMER SCHOOL OF MINING ENGINEERING. — The Summer School of Mining Engineering was this year held in Nova Scotia. Visits were made to mines, coke works, and furnaces; those to the mines were given the most prominence.

The party numbered fourteen, including Professors Richards and Hofman, Assistant Watts and eleven students of the second, third, and fourth years in the Department of Mining Engineering and Metallurgy. The party studied the plants and the methods of operation at the gold mines, mill and chlorinating works of the Brookfield Mining Company, Limited, at North Brookfield; at the coal mines of the Cumberland Railway and Coal Company at Springhill, of the Canada Coal and Railway Company at Joggins, and of the Intercolonial Coal Company, Limited, at Westville; at the iron mine, coke ovens, iron furnace and steel works, near New Glasgow, of the Nova Scotia Steel Company, Limited; at the coke and gas works of the Peoples' Light and Heat Company, Limited, at Halifax; and at the gold mine and mill of the Golden Group Mining Company, Limited, at Montagu.

Besides the above more strictly professional studies, excursions were made with Mr. B. B. Barnhill of the class of '73 at Joggins to inspect the geological exposures, and at Partridge Island to collect minerals occurring in the trap formation. The thanks of the department and of the Institute are due to the gentlemen in charge of the above works for the kind and sympathetic interest taken in the students, to whom the freedom of the works was cordially granted.

Course IV., Architecture. — The only important change in the courses of study offered by the Department of Architecture has been the introduction of the new option in Architectural Engineering. For some time it has been felt that a demand existed for men specially trained in the computation of all the details of modern steel construction, and that the regular course should be so modified that under-graduates might be allowed a choice between the academic and engineering sides of architecture. This choice is now offered at the middle of the third year, the introduction of courses in structures and structural design, in place of academic design, constituting an important addition to the engineering side of the established courses of the department. It is to be hoped

that graduates as well as under-graduates will take advantage of opportunities offered by this option.

By far the most important event during the past year has been the change to the new quarters in the Pierce Building. For the third time since 1883 the department has had to change its location in order to meet the constant need of expansion. From the small rooms at the top of Rogers it has so grown that it now occupies two and one-half floors of the Pierce Building and the large room at the top of the Dynamo Building.

The new quarters provide space for all the rooms of the former Architectural Building, and in addition give opportunity for increased accommodation for the architectural library, exhibition-room, and fourth-year and graduate drawing-rooms. The library and fourth-year drawing-room have now double the area of the old room, and the former crowding and interference have entirely disappeared. We are also to be congratulated on the fact that the library is now placed in a fireproof building where its valuable books will have proper protection. The adoption of the alcove system in the library greatly assists in the effective use of books by bringing together works of the same period and subject. The library is not only better arranged than heretofore, but also has room for the addition of some 800 quarto volumes, 250 large folio volumes, 10,000 photographs, and 12,000 lantern slides. Better table space is also provided, and many periodicals, catalogues, and plates formerly not accessible can now be placed on the shelves. In addition, an entire alcove has been devoted to the exhibition and use of books and photographs relating to the course on the History of European Civilization and Art.

The new exhibition room gives ample opportunity for the display and comparison of designs and sketches, and the continuous exhibition of students' work. It is therefore an important aid in architectural training. The new drawing-rooms are all that could be desired, and their walls are

rapidly being covered with the best examples of academic drawing and details of classic buildings. Daylight is well diffused by the special glass and light-colored walls, so that all parts of the room can be used to advantage. At present there are the following desks in the different drawing-rooms. The number which could eventually be placed in the rooms is given in the second column:

Second-year drawing-room,	37	desks;	limit	about	56	desks.		
Third-year	"	"	46	"	"	"	75	"
Fourth-year	"	"	41	"	"	"	56	"
Graduate	"	"	11	"	"	"	15	"

The new architectural studio is also a great improvement on the old room, for it now has both direct and north top light in addition to the light from the side windows. The great north skylight in this room gives a superb light for life-class work.

At present the department feels the need of large casts in order to familiarize the students with the scale and actual size of good architectural detail. The full-size models of the orders from the Theatre of Marcellus and the full-size cornice from the Temple of Concord at Rome have proved excellent aids in class work and general instruction, but more examples are needed, and it is hoped that a series of such casts from historic buildings may be obtained in the near future.

The prizes annually given to students in the department were this year awarded as follows:

Rotch prize, $100, for student graduating with greatest distinction, Mr. G. P. Stevens.

Rotch prize, $100, for special student completing course with highest standing, Mr. A. H. Cox.

Boston Society of Architects' prize, $50, Mr. E. H. Schroeder.

Boston Society of Architects' prize, $50, Mr. H. P. Richmond.

It may also be interesting to state that during the past

summer Professor Chandler has been head of the Architect's Department of the city of Boston and a member of the Fine Arts Commission; Professor Despradelle is one of the eleven competitors chosen for the second trial in the great Phœbe Hearst world competition for the University of California; Professor Homer has had charge of the construction of the new buildings of the Institute.

Courses V. and X., Chemistry and Chemical Engineering. — The removal of the third-year students in analytical chemistry to their new laboratory on the third floor has made available some additional space much needed for the growth and development of the fourth-year work.

The organic laboratory has been considerably enlarged during the preceding summer, so that it now accommodates thirty-six students instead of thirty as heretofore. It has, moreover, been much improved by a large increase in the number of hoods, by a more convenient arrangement of desks, and by the construction of a new skylight, so that the laboratory is now thoroughly lighted.

A laboratory has been equipped for the new course in proximate technical analysis referred to in the report of last year. This course, it will be remembered, comprises the examination of such industrial products as asphalt, rubber, soap, paper, and tannins, and is taken as an option by the larger number of the chemical students in their fourth year.

The facilities for thesis work have been increased by the construction of a photographic dark-room and of a tool-room equipped with a power lathe.

Several of the theses made by the chemical students during the past year have yielded results worthy of publication, fifteen or more articles on theoretical, analytical, and organic chemistry having been published by instructors and students.

No important changes have been made in the courses of instruction in organic chemistry. The fourth-year work has, however, been extended by the introduction of a lecture course on the history of chemistry, given by Dr. Norris,

and by that of a laboratory course in electrical and heat measurements in charge of the Department of Physics.

ANALYTICAL CHEMISTRY. — The total number of students taking analytical chemistry is 135; 92 taking qualitative and 43 quantitative analysis.

This total is larger than it has been ever before, but, with the exception of four students who work but three hours per week, and for whom special provision has been made, each student has a full desk at his disposal. The advantages in increased facility, both of teaching and working, are plainly apparent.

The analytical laboratory on the fourth floor of the Walker Building accommodates, since the alterations of the summer, ninety students, and the new laboratory on the third floor, which occupies the rooms formerly used for the textile coloring laboratory and a private laboratory, has working places for sixty students. The upper laboratory is now used wholly for students taking qualitative and preliminary quantitative analysis, while those taking more advanced quantitative analysis have desks on the third floor. The new laboratory is equipped with steam tables, steam baths, drying closets, and funnel closets of ample capacity, and gives promise of excellent service.

A new private laboratory for the use of the instructors greatly facilitates their work with the students. The former lecture room, which also connects directly with the new laboratory, has been converted into a private laboratory and office for Professor Talbot, and in convenience of access and general accommodation is proving highly satisfactory.

The absorption of the former balance-room on the fourth floor by the Organic laboratory made it necessary to transfer the balances to the former volumetric room, and to do away with the reservation of a special room for this work. The volumetric room was not sufficiently large to accommodate the entire number of students at work in that line, and so much of the volumetric work was necessarily done in the

large laboratory that the transfer of all will not cause a serious drawback. A new balance room is provided on the third floor, and the two rooms will furnish places for thirty balances.

The number of students in the upper laboratory is unusually large this year owing to the exceptional number in Course III., third year, and to the fact that a considerable number of students of the second year of the same course have satisfied the language requirements, and are anticipating the chemical work of the third year. Many of these students will enter the new laboratory next year, and will perhaps tax its capacity; but it does not now appear that the numbers will be as large in the following years.

In general, it may be said that the division of the work in analytical chemistry which is now made possible by the use of the second laboratory seems to be productive of increased ease in teaching, and to be generally beneficial. The changes are of such a nature that if further expansion becomes in time necessary, it can be accomplished with a minimum of change.

The transfer of the supply room to the room formerly known as the Margaret Cheney room is regarded as an improvement in itself, and the room formerly occupied as a supply-room is available as a research laboratory.

The portion of Room 3 formerly the industrial laboratory, which has been reserved to furnish a passageway to the vault, supplies the space needed for the unpacking of goods, and may also be used for special lines of chemical work.

The chemical library has received about the usual number of additions, and is believed to be supplied with all valuable works published during the year.

The outlay for apparatus to equip the new laboratories must necessarily involve a larger net expenditure for this year than is usual in the Department of Chemistry. This is, of course, a temporary demand.

SANITARY CHEMISTRY. — No new work has been undertaken. The pressing demands for space and time in other di-

visions of chemistry seemed to render advisable a temporary pause in the development of a subject which, both in its theory and in its applications, is of growing importance.

The students have had, as before, the benefit of many of the practical problems which are constantly brought to this laboratory from all parts of the country.

Mrs. Richards has had leave of absence for a few weeks in order that she might accept a position on the Faculty of the College for Women, Western Reserve University, Cleveland, where she is to give a course of lectures on the Economics of the Household interpreted in the light of Sanitary Science.

Several other colleges have availed themselves of Mrs. Richards' presence in the West to secure one or more lectures on Sanitary Science and the Chemistry of Food Materials.

OIL AND GAS ANALYSIS. — The facilities of the laboratory of Oil and Gas Analysis have been increased by the conversion of the small lecture-room into a private laboratory. A Hinman portable photometer has been added to the equipment of the laboratory.

The department still continues to give instruction to the mechanical and electrical engineers and naval architects in the subject of Gas Analysis. This includes not only the examination of chimney gases, but also the discussion of fuels, smoke prevention, and smokeless furnaces.

SUGAR ANALYSIS. — During the past year, owing to a change in the schedule, both junior and senior classes were given instruction in the regular fifteen-hour course in sugar analysis, making about forty students of Course V. Some extra instruction was given to the juniors who were lacking in experience in physical measurements and manipulation of instruments of precision, and their progress proved satisfactory. Four or five students were also given instruction out of course by permission of the Faculty. — Three students took thesis work in this laboratory: G. F. Ulmer ("An Analytical Investigation of the Torrefaction Dextrines"); W. H. Barlow ("The Hydrolysis of Cellulose"); A. L. Goodrich ("Com-

parison of Actual 'Total Solids' of Cane and Beet Juices with those obtained by the Brix Spindle").

The change of location of the laboratory is on the whole a decided improvement, as the present room has been specially fitted for the work.

INDUSTRIAL CHEMISTRY. — During the past summer the laboratory of industrial chemistry has been transferred to new and more commodious quarters in the Pierce Building. The laboratories comprise three work-rooms, large and small store-rooms, and private laboratories for the instructors.

The main laboratory is a room about 56 ft. × 37 ft. 6 in. It is lighted by seven windows in each end and by two large skylights, and is furnished with fourteen 50-candle-power incandescent electric lamps, thus insuring an abundance of light at all times. The ventilation of this new laboratory is far superior to that of the old one, the ventilating system being augmented, in this room, by three large ventilating cowls in the skylights. The number of steam evaporators has been increased from twelve to twenty. They are arranged in a corner of the room and under the skylight having the largest ventilating cowl, which carries off the steam from the evaporators.

The work-benches contain drawers and cupboards for forty-eight students, and that number can be accommodated by having two sections, there being ample bench room for twenty-five students at a time. In addition, there is a large bench set apart for the qualitative and quantitative examination of materials used and of product obtained. The benches are fitted with gas and suction pipes, and a portion of them also with water and waste pipes for distillations. The large gas burners are connected directly with the gas supply, thus avoiding the use of rubber tubing and consequent danger therefrom. The suction pipes — fitted with a tap for each student — are connected with Richards filter pumps and also with a new power-driven combined vacuum and pressure pump, which will also furnish compressed air for various purposes.

This laboratory has five new hoods with glass fronts and sides and soapstone tables. A notable feature is the ample water supply and sink space, there being five sinks placed in a row in the middle of the room, fitted with eight water taps, and having thirty-five feet of working room round them. A new Fletcher's largest size combined crucible and muffle-gas furnace has been added to the equipment for metallurgical work. The efficiency of the hydro-extractors has been increased by the addition of nickel-plated baskets of different sizes, so that small or large quantities of materials can be operated upon with equal facility. The extractors are arranged to be driven direct from an electric motor. A line of shafting driven by the electric motor serves to distribute power to the various machines.

The small industrial laboratory contains the filter press and large knuckle-joint press, and also specimens of work of the students, contained in cases. One-half of this room has been reserved for the students' use as a reading-room. It is furnished with a library table and twelve chairs, a large blackboard, and a small library of works of particular interest to students in industrial chemistry and textile coloring.

The textile coloring laboratory is a room about 40 ft. × 27 ft. 6 in., specially designed for its purpose. Its roof consists of four large skylights facing the north. These and the walls of the room are painted white, which insures the best light for the matching of colored fibres and fabrics. The room is furnished with new benches and work-tables fitted with new and improved dyeing apparatus. They are so arranged that each student has ample room for dyeing on the table at his right hand, and a bench with drawer and cupboard, a balance and all necessary apparatus at his left. A small steam-heated apparatus for aging aniline black colors has been fitted up in this room. A new steam-heated distilling apparatus has been added. It is automatically controlled, requires no attention, and supplies an abundance of distilled water for all needs in the textile and industrial chemistry laboratories.

The class in industrial chemistry this year is slightly smaller than in the two previous years, there being forty-three students enrolled. A slight change in arrangement of the lectures has been made, by which the first six or eight lectures are devoted to the general operations, such as crushing and grinding materials, solution, filtration, evaporation, crystallization, etc., which are commonly employed in all industrial processes. Following these the more important manufactures are taken up in detail, these lectures forming the major part of the course. In addition to written exercises, oral "quiz" exercises are now held in connection with the course, and assist in making clear many obscure points. The completion of Dr. Thorp's text-book will relieve the students from a part of the note-taking during the lectures and furnish them with a digest of the matter covering nearly all important points. The usual number of lectures continues to be given by gentlemen not connected with the instructing staff of the Institute. The customary excursions to factories will be arranged, and in this connection thanks are due to the following-named gentlemen for courtesies extended to the classes: Mr. A. P. Howard, Superintendent Merrimack Chemical Company; Mr. J. deCordova, President Union Glass Company, Somerville; Mr. G. E. Jordan, Agent, and Mr. Getchell, Superintendent, Waltham Bleachery and Dye Works, Waltham; Mr. Thomas H. Hintze, Superintendent Malden and Melrose Gas Light Company, Malden; Mr. E. D. Mellen, Treasurer Curtis, Davis & Co., Cambridgeport; Messrs. Hollingsworth & Whitney, proprietors of the Mattapan Paper Mills, and Mr. Mosman, Superintendent of the mill; Mr. D. J. Flanders, General Passenger Agent, Boston & Maine R.R., for special rates and transportation provided on several of the excursions.

Books Published.

H. P. Talbot: An Introductory Course of Quantitative Chemical Analysis (Third, revised and enlarged edition).

F. H. Thorp: Outlines of Industrial Chemistry.

F. H. Thorp: Inorganic Chemical Preparations.

G. W. Rolfe: Introduction to Sugar Analysis.

ARTICLES PUBLISHED.

Henry Fay and H. P. Talbot: On the Segregation of Carbon in a Piece of Boiler Plate.

J. F. Norris and Henry Fay: Iodometric Estimation of Tellurium.

J. F. Norris and A. I. Franklin: Composition of Nitrogen Iodide.

J. F. Norris: Some Double Salts containing Selenium.

A. G. Woodman: The Differentiation of Organic Matter in Water.

E. H. Richards and I. F. Hyams: *Oscillaria Profilica* in its Relation to Water Supply.

A. H. Gill and A. C. Lamb: The Constants of American Linseed Oil.

A. H. Gill and I. Hatch: On the Bromination Test for Oils.

G. W. Rolfe and Geo. Defren: The Manufacture and Use of Brewing Sugar in America.

A. A. Noyes: 1. Reliability of the Dissociation Values determined by Electrical Conductivity.

2. Die Theorie der Löslichkeitsbeeinflussung bei zweiionigen Elektrolyten mit lauter verschieden en Ionen.

A. A. Noyes and E. H. Woodworth: Investigation of the Theory of the Solubility Effect in the Case of Triionic Salts.

A. A. Noyes and D. Schwartz: The Solubility of the Salts of Weak Acids in Stronger Acids.

A. A. Noyes and E. S. Chapin: The Solubility of Acids in Solutions of the Salts of Other Acids.

A. A. Noyes and L. J. Seidensticker: The Solubility of Iodine in Diluted Potassium Iodide Solutions.

A. A. Noyes and G. T. Cottle: The Velocity of the Reaction between Silver Acetate and Sodium Formate.

Dr. Thorp's Outlines of Industrial Chemistry deserves a

special mention. It is designed for the use of students, and is also furnished with references to original work which will make a guide to the entire literature of the subject. It gives a concise and clear account of manufacturing processes, with an explanation of the chemical principles involved, and supplies a want long felt by teachers.

Courses VI. and VIII., Electrical Engineering and Physics. — The school year 1897–8 has been one of healthy growth in this department. The time gained in the fourth year in consequence of the advanced mathematical requirements for admission to the Institute has allowed the introduction into the Course VI. of a very large amount of additional instruction in the laboratory with great benefit to the students; furthermore, the instruction in dynamo design has been greatly extended. These exercises, however, seriously tax the resources of the department both as to room and instructing force. The same should be said of other additions to the instruction given in the department.

While the actual number of students taking Course VI. has suffered a diminution, coincidently with the increase of certain other courses, the actual work of the Department of Physics, which as a whole is determined more by the variety and specialization of the instruction given than by the actual number taught, shows every year a material increase. I cannot better illustrate this than by the following extract from a statement written a few months since to the Chairman of the Visiting Committee for the department:

"To the fourth-year students in electrical engineering we are this year giving, for the first time, five hours a week instruction in the electrical engineering laboratory, throughout the whole second term. This means that there are five sections in that laboratory, one section every day except Saturday, and practically from eleven to five each day. This is new work, replacing in part the mathematics, which in consequence of the advanced entrance requirements is now taken earlier in the course. In other branches there is also a marked increase of the work done in Courses VI. and VIII.

"But this is by no means all. From the beginning of the Institute the subject of physics has been recognized as of fundamental importance to all students in whatever department they might be studying, and with the development of the school the call for more instruction in special branches of physics, for the benefit of students outside the courses in physics and electrical engineering, has greatly increased. Within the past two years the Physical Department has been called upon to give lectures in applied electricity to all regular students in civil, mechanical, chemical and sanitary engineering, and chemistry, and to many of the mining engineering students as well. We have been asked to give, and hope next year to give, laboratory instruction in dynamo testing to all the mechanical engineering students of the third year. We have introduced an extended laboratory course in heat measurements for all the students in mining engineering, which course is also optional for students in chemistry. Also a course in the laboratory of physical chemistry is required by the course scheme of all chemists of the fourth year. Furthermore, the proposed new scheme of the course in architecture contemplates courses of lectures upon sound as related to architecture, and color, and also one upon the electric lighting of buildings.

"The bare enumeration of these important advances, all of them practically introduced or made effective within the past two years, will show the manner in which the advanced work in physics permeates almost every professional course in the Institute. It also shows that the increasing numbers of students in mechanical engineering, chemistry, and mining engineering and other courses have an immediate effect in increasing the demands upon the Department of Physics."

Apart from the introduction of new courses of instruction, those already existing, without exception, have been materially strengthened, so that the teaching of the department has never been more thorough than at present.

A number of valuable scientific papers have been pub-

lished from the department. There is, moreover, much material embodied in the theses from year to year which is well worthy of publication, if the time of the instructors were not so severely taxed as to render it difficult to put this into suitable shape.

A new edition of the circular relating to the courses in electrical engineering and physics was issued during the summer. Five years had elapsed since the issue of the previous one, and a comparison of the two will show the marked advance that has taken place in that interval.

The following gentlemen engaged in professional work have kindly given lectures during the school year 1897–8, many of them entirely without compensation:

Mr. George W. Blodgett, Electrician of the Boston & Albany Railroad, on the Application of Electricity to Railway Signalling; Mr. Hammond V. Hayes, Electrical Engineer of the American Bell Telephone Company, on Telephone Engineering; Mr. C. J. H. Woodbury, of the American Bell Telephone Company, on Electricity in its Relation to Fire Risks; Mr. Louis Bell, on the Electrical Transmission of Power and the Application of Electricity to Railway Transportation; Mr. S. Everett Doane, of the Marlboro' Electric Company, on the Manufacture of Incandescent Lamps; Mr. Hollis French, on Electrical Engineering Practice and Specifications; Mr. Howard C. Forbes, on the Design and Testing of Electric Light and Power Plants; Mr. John B. Blood on the Design of Alternating Current Machinery; and Mr. Odin B. Roberts, on the Nature and Function of Patents for Inventions.

Many additions have been made to the stock of apparatus of measurement and demonstration since the issue of the last President's Report, especially in heat and electrical measuring instruments. The photometric apparatus has also been brought up to date; and among other instruments a Koenig spectrum photometer has been added thereto. This was purchased from the income of the Katharine Bigelow Lowell

Fund. From the same fund has also been provided a high-grade modern automatic air-pump, the need of which for lecture purposes has long been felt. An unusual amount of apparatus has been constructed in the workshop of the department by the mechanician. Our facilities for such work have been increased by the addition of an engine-lathe larger than any hitherto in our possession.

A number of important changes have been made in laboratory rooms. The laboratory of heat measurements has been enlarged by the addition of a portion of the space vacated by the removal of the laboratory of industrial chemistry. This addition doubles the size of the former room and more than correspondingly increases its availability. While not allowing room for much growth or development, it is sufficient for the present needs of the work and will probably suffice for several years. The necessity for increased space in this laboratory has arisen, not from the demands of students in electrical engineering, who do not receive instruction therein, nor of those in physics, whose needs were previously satisfied, but from the constantly increasing instruction which this department offers to other courses, — in this instance, to those of chemistry, chemical engineering, and mining engineering. This is as it should be, for one of the noteworthy characteristics of the Institute, and one which has contributed very largely to its success, is the manner in which the work of the various departments is coördinated so that each does its appropriate part in the training of every student, forming a marked contrast to the policy of departmental isolation so often followed.

The laboratory of chemical physics has received a large increase in area through the absorption by it of an adjoining room hitherto devoted to certain work in electricity. This increase was imperative unless this laboratory was to curtail its work with the students of Course V. The room is now sufficient for the present work of instruction, but the growing demand for training in this new and important branch is

liable to cause crowding again before many years. The necessities of this laboratory have led to the removal of the photographic dark-room to another place. This has been reduced in size and placed in a corner of the acoustic laboratory.

The loss of room which has thus been sustained by the laboratory of electrical engineering, though unavoidable, is much to be regretted. An endeavor has been made to gain such room as is possible by a rearrangement of apparatus. The small room on the second floor formerly reserved for special measurements of electrical resistance has been converted into a photometer room for use with electric lights. The electric signalling apparatus, a portion of which was erected in this laboratory, is to find a location in one of the buildings on Trinity place, where it is expected to erect the whole of this large and valuable illustrative collection. A small increase has been made to the dynamo-room by the addition of a strip formerly belonging to the laboratory of industrial chemistry.

As to the serious manner in which the work of the department is hampered by lack of room, I can add nothing to what has been said in the Presidents' Reports of the past two years. In the laboratory of heat measurements the need has been met by a substantial addition, and in that of physical chemistry by taking a portion of the laboratory of electrical engineering, as already explained. But this has still further diminished the space devoted to electrical engineering and physics, for which no satisfactory provision has yet been found.

Professor Holman, who has for several years been debarred from school work by severe illness, has published a book upon Matter, Energy, Force, and Work, for the use of those who are dealing professionally as engineers, teachers, or students with these physical concepts. The book is dedicated to the Institute, and it is a remarkable effort of a keen and judicious mind remaining in touch with the work which

was loved so long and done so well. Mind dominating matter might well have been the sub-title of this valuable treatise, and the Institute accepts the dedication with respectful appreciation.

EXCURSIONS OF ELECTRICAL ENGINEERS. — An important feature in connection with the course of electrical engineering in the fourth year is the number of excursions that are made to the various electrical plants and factories in the immediate vicinity of Boston. Here it is that the student sees, generally for the first time, in actual commercial shape, the embodiment of the principles with which he has become familiar in the class-room and laboratory. He is intensely interested, and spends far more time on related problems than he would if these were presented only in a text-book or lecture. These excursions are frequently undertaken by the Electric Club, generally after consultation with some one of the instructing staff, and may be attended by the third and fourth year students.

The longest excursion in the past year, and one that was most highly appreciated by the class, was made under the charge of Professor Puffer, to the great factories of the General Electric Company, at Schenectady, N.Y., in the vacation following the semi-annual examinations.

An excursion like this has the value of a long experimental lecture, illustrated in a large way by machines in all stages of completion. It makes the students acquainted with the best electrical engineering method of dealing with the problems of the day, and of anticipating the wants of the near future.

Course VII., Biology. — For several years the quarters available for the Department of Biology have been totally inadequate. Class work and research have been carried on in one large room, subdivided by partial screens and partitions.

In the Pierce Building the department has now five laboratories, entirely separated one from another; namely, a second-year, or general, laboratory for all the larger classes, but especially for those in general (elementary) biology, micros-

copy, general zoölogy, and elementary botany. This room is used also by the classes in theoretical biology, and in the history of inductive science, as well as by the Journal Club of the department, and for occasional meetings or special lectures. There is, in the next place, a third-year laboratory of smaller size, used almost constantly by the classes in comparative anatomy and embryology, and in cryptogamic botany. Here, also, the fourth-year class in microscopic anatomy does its practical work. Two laboratories are devoted exclusively to the work of the fourth year, one to physiology, and one to bacteriology and its applications to industrial biology and sanitary science. A fifth, the research laboratory, is set apart for the use of investigators, who may be members of the instructing staff, graduate or special students, or regular students engaged in special investigation, such, for example, as thesis work.

In addition to the biological laboratories proper the suite of rooms provided for this department includes four private rooms for the offices, libraries, and personal effects of members of the instructing staff; dark-rooms for optical and photographic work; store and preparation rooms; and a library and reading-room in which are placed the biological books and periodicals belonging to the Institute. The floor area occupied by this new suite of laboratories, etc., is only about two and one-half times that vacated in the Rogers Building, but owing to the shape of the Pierce Building and the careful planning of the whole the convenience and efficiency of the new arrangement are far greater than these figures would indicate.

It is probably entirely fair to say that nowhere in the United States is there so compact or well-arranged a series of laboratories devoted chiefly to the sanitary, hygienic, and industrial aspects of biology. They should be a powerful aid to the Institute as a whole, not only in their own peculiar province, which is daily revealing fresh and important applications to modern life, but also as an ally in the train-

ing of the chemist, the civil and the sanitary engineer, the architect, the geologist, and the student of general science.

The work of the year in this department has been continued on the lines already established in previous years. Professor Sedgwick continues to serve the public in his capacity as an authority on sanitary science and the public health, two large cities in particular, Pittsburgh, Pa., and Newark, N.J., having recently referred to him for solution important questions relating to the purity of their water supplies. Side by side with this work in public hygiene, Professor Hough has begun the extended investigation of an important problem in personal hygiene, viz., the physiology of muscular exercise. Dr. A. W. Weysse, Instructor in Comparative Anatomy, has lately published, with Messrs. Longmans & Co., a useful volume entitled "An Epitome of Human Histology." Mr. S. C. Prescott, Instructor in Bacteriology and Industrial Biology, in coöperation with Mr. W. Lyman Underwood, has carried to a successful issue further researches on the theory and practice of food-preserving, with the result that the Biological Department of the Institute is now regarded by those conversant with the canning industries as the centre of scientific information in the United States for these industries.

This department, which was already under great obligations to Mr. Augustus Hemenway for the gift of a number of high-power microscopes, has recently received from his hand a generous contribution for the purpose of maintaining for the current year a much-desired graduate scholarship in biology. Mr. C.-E. A. Winslow, a graduate of the Institute in Biology in the class of 1898, has been appointed to hold this scholarship, and has entered on its privileges, having for this purpose resigned his position as Assistant Inspector of the Board of Health of Montclair, N.J.

Course IX., General Studies. — In the report of last year mention was made of the introduction of a new course to be given to fourth-year students in electrical engineering on

economics of corporations. This has been successfully undertaken. A list of the topics treated is as follows: the historical and legal development of corporations, forms of securities issued, analysis of corporation accounts, regulations in Massachusetts upon issue of securities, the position of quasi-public corporations concerned with the industrial application of electricity, taxes, status and organization of municipal corporations, street railway franchises, and control of electric lighting.

In accordance with a request from the Department in Biology, a brief course will be given this year by Professor Dewey to students of Course VII., on vital and sanitary statistics. This is designed to furnish elementary information in regard to the proper interpretation of registration and health reports which are necessary in problems of public hygiene.

The course heretofore known as "history and literature of the Renaissance and Reformation" has been rearranged and somewhat modified, and the lectures last year given to the students in architecture as a separate course on "the history of sculpture and painting" have been combined with it, the whole being now entitled "history of European civilization and art, principally in the classical, gothic, and renaissance ages." The class now meets in one of the lecture-rooms of the Department of Architecture. A considerable number of books has recently been purchased by that department with a view to the special needs of this course, and an alcove in the new departmental library has been fitted up with cabinets and show-cases for photographs. The collection of lantern-slides and other illustrative material has also been considerably increased — notably by a fine series of photographs of Greek sculpture.

The English Department has during the year endeavored to develop the scheme for the supervision of the written work of students past their first year. Many students have been given special work in writing, and have been guided by

personal advice in consultation. The results have been good, and seem to justify the belief that in this direction lies the secret of the most efficient training of those pupils who are by nature less gifted than others in the power of expression.

An encouraging sign of the increased interest in English is the fact that the advanced composition given for the third year of Course IX. is this term taken as an elective by more than twenty students from other courses. As several of these students are from Course IV., there is reason to believe that the work of the English Department in connection with the architectural memoirs has called attention to the desirability of more facility in composition on the part of those graduating in this course. It is the desire of the department that the system of having papers which are written in regular technical work specially corrected for their English should be extended to all courses.

Course XII., Geology. — The regular work of the classes as represented in the catalogue has been carried out during the year.

The leading event of the year has been the removal of the entire department from the Rogers Building to the new Pierce Building, Trinity place. That opportunity might be given for extensive alterations of the Rogers Building it became necessary to store the whole equipment of the department during the vacation weeks. More recently much time has been occupied in finishing and equipping the new rooms and in arranging the materials for the regular work of instruction. Although there has been much confusion and considerable delay, the classes have not been omitted nor neglected, but the instruction has not been as complete as it would have been if full use could have been had of the department collections.

The arrangement of the new rooms is found to be a decided improvement upon the former one. The articles that are needed for the different classes can now be used either in the room in which they are kept or in an adjacent one with

almost equal ease. Perhaps the most significant advantage of the new quarters is to be found in the mineralogy room. It is now fitted with tables with slate tops, and with drawers in which each student may safely keep his own instruments and notes distinct from others. A large case with many drawers provides for keeping in easy access the specimens to be used in teaching mineralogy. The ventilation and general arrangement of the room are such that the quality of the air in the room during two-hour exercises at blowpipe analysis is very much better than it has been before. The machine for slicing, grinding, and preparing thin sections for study and for giving students practice in this important kind of work is now placed in the same room, and its new location will be a great convenience.

Another important feature is that a special room has now been assigned for economic geology. Where the department was formerly located there was no opportunity for making satisfactory collections for teaching this important branch of the science. As it is now arranged the classes in ore deposits, building stones, and other advanced studies will be accommodated and receive instruction in the same room in which the collections are kept.

The geological library and laboratory are now much better accommodated than previously. In the former room it was impossible to arrange the books as in other department libraries; consequently it was with much difficulty that they were consulted. The size of the valuable palæontological collection was beyond the capacity for keeping it, and some of it remained in boxes and trays which encumbered the rooms. The new room is provided with a larger number of drawers so conveniently arranged that the work can be carried on with comparative ease and facility. A similar improvement has been made in the room for structural geology. The case-room has been largely increased, the room is well equipped, and the facilities for instruction are now satisfactory. The lecture-room is pleasant and very conveniently located.

On account of the value of space the method of keeping the collections in drawers has been generally adopted, only a few specimens being displayed. With the museum of the Boston Society of Natural History so accessible we may well use our own collections solely for the purpose of teaching. The department is now supplied with more than twelve hundred drawers for the convenient keeping and systematic arrangement of its specimens, maps, charts, and appliances for giving instruction.

Course XIII., Naval Architecture. — The work in the department of Naval Architecture is much facilitated by the commodious quarters now occupied. The drawing-room work is better in quality and larger in amount than in former years, because the students are less subject to interruptions and can make drawings to convenient and customary scales. This, together with the advance made in methods of drawing-room instruction, makes it possible to devote practically the whole of the drawing of the fourth year to design, and enables the students to make a design for a ship which shall be as complete as it is desirable to undertake in a technical school.

The valuable collection of drawings and models in the possession of the department is now assembled and arranged for convenient use, and steps have been taken to increase largely the number of both drawings and models.

Mr. James Swan, formerly Instructor in Naval Architecture, has resigned in order to take charge of the scientific department of the drawing office of the Newport News Shipbuilding Company. His work has been intrusted to Mr. Carl H. Clark, a graduate of the class of 1895 from the department of Naval Architecture, who has since been engaged as assistant and instructor, part of the time in marine engineering, and part of the time in naval architecture. He has also had some experience in designing both ships and engines.

Professor Peabody took an active and leading part in the consultations which were held this summer with reference to the programme of studies for United States naval constructors,

and laid out a course of advanced studies directed toward the special problems involved in the construction of warships. This programme formed the basis of the one which was eventually presented by the Faculty to the Naval Department.

Summer Courses.

These courses were given by our instructors with the attendance indicated. They may now be regarded as a well-established auxiliary to our regular work.

Programmes of Summer Courses.

I. Mechanical Drawing and Descriptive Geometry. 27. (Prof. Faunce.)
II. Mathematics: Analytic Geometry. 8. (Mr. George.)
III. Architecture. (*a*) Shades and Shadows. 4. (*b*) Elementary Design. 9. (Mr. Gardner.)
IV. Chemistry. (*a*) Analytical Chemistry. 23. (Dr. Walker.) (*b*) Water Analysis, and Air Analysis. 2. (Mrs. Richards.)
V. Physics. (*a*) Mechanics, Light, and Electricity. 7. (Mr. Drisko.) (*b*) Heat. 11. (Prof. Clifford.) (*c*) Physical Laboratory. 10. (Prof. Goodwin.) (*d*) Electrical Testing. 5. (Prof. Laws.)
VI. European History. 3. (Mr. Wentworth.)
VII. Modern Languages. (*a*) French. 5. (Mr. Bernard.) (*b*) German. 11. (Dr. Dippold.)
VIII. Mechanism. 8. (Prof. Merrill.)
IX. Shopwork. (*a*) Carpentry and Wood Turning. 4. (Mr. Merrick.) (*b*) Forging. 9. (Mr. Lambirth.) (*c*) Chipping and Filing. 8. (*d*) Machine Toolwork. 24. (*e*) Metal Turning. 2. (Mr. Smith.) (*f*) Pattern Making. 3. (Mr. Merrick.)

The "Technology Review."

During the last year the project of a publication intended to reach all the alumni has been carefully considered, and the "Technology Review" (quarterly) is to appear on the first day of January.

The "Review" is planned to be true to its name, and to look over all the widespread fields of interest into which our Institute has entered, to give news of the School to

the graduated classes and of the classes to each other, and to have an educational and literary side attractive to the general reader.

Class life during our busy school years is less active than in most colleges, but the close affiliations or kindred pursuits of the professional work of after years draw graduate class associations together by the closest bonds. They have reason to review their mode of life and training at the Institute during every year that they practise the professions for which we endeavored to educate them; and it is hoped that this new quarterly will be welcomed as a medium for communication about such matters.

STATISTICS.

THE CORPS OF INSTRUCTORS.

The catalogue of 1898–99 shows the number of instructors of all grades to be 134, inclusive of those concerned with the mechanic arts, but exclusive of those who are announced as lecturers for the year only. The addition of these raises the total to 164. Allusion has already been made to the augmentation of the number of the instructing staff; without counting lecturers, the number of instructors to that of students bears the proportion of one to eight and eight-tenths. This proportion is a most characteristic figure, and is intimately associated with the quality of the instruction. The following table shows the distribution among the several classes of instructors, in comparison with last year:

	1897–98	1898–99
Professors	23	23
Associate Professors	8	7
Assistant Professors	23	23
Instructors	53	53
Assistants	25	28
Lecturers	26	30
Total	158	164

Students and Graduates.

The registration of this year, as by the catalogue now in press, amounts to 1,171. The following table shows the registration of successive years from the foundation of the Institute:

Year.	No. of Students.	Year.	No. of Students.
1865-66	72	1882-83	368
1866-67	137	1883-84	443
1867-68	167	1884-85	579
1868-69	172	1885-86	609
1869-70	206	1886-87	637
1870-71	224	1887-88	720
1871-72	261	1888-89	827
1872-73	348	1889-90	909
1873-74	276	1890-91	937
1874-75	248	1891-92	1,011
1875-76	255	1892-93	1,060
1876-77	215	1893-94	1,157
1877-78	194	1894-95	1,183
1878-79	188	1895-96	1,187
1879-80	203	1896-97	1,198
1880-81	253	1897-98	1,198
1881-82	302	1898-99	1,171

Students by Classes.

The aggregate number of students for 1898–99 is divided among the several classes as follows:

Fellows	4
Graduate students, candidates for advanced degrees	3
Regular students, Fourth Year	181
" " Third "	189
" " Second "	204
" " First "	282
Special students	308
Total	1,171

Assigning the special students to classes, according to the predominant studies pursued by them, we reach the following division of the whole body among the several years:

Class.	Regular.	Special.	Total.
Fellows	4	...	4
Graduates of the M.I.T.	3	...	3
Fourth Year	181	60	241
Third Year	189	106	295
Second Year	204	103	307
First Year	282	39	321
Total	863	308	1,171

THE COURSES OF INSTRUCTION.

The following table presents the numbers of the regular students in the second, third, and fourth years, by courses:

YEAR.	Civil Engineering.	Mechanical Engineering.	Mining Engineering and Metallurgy.	Architecture.	Chemistry.	Electrical Engineering.	Biology.	Physics.	General Course.	Chemical Engineering.	Sanitary Engineering.	Geology.	Naval Architecture.	Total.
4th Year Class.	32	37	9	22	23	36	1	3	1	10	1	..	9	181*
3d " "	34	34	24	20	16	27	4	2	6	11	3	..	9	189*
2d " "	27	37	19	22	25	31	1	3	5	17	3	1	15	204*
Total . . .	93	108	52	64	64	94	6	8	12	38	7	1	33	574*

The following table shows the figures of the total line in the foregoing table, in comparison with the corresponding figures for the next ten preceding years:

YEAR.	Civil Engineering.	Mechanical Engineering.	Mining Engineering and Metallurgy.	Architecture.	Chemistry.	Electrical Engineering.	Biology.	Physics.	General Course.	Chemical Engineering.	Sanitary Engineering.	Geology.	Naval Architecture.	Total.
1887	50	89	16	18	23	61	5	6	14	..	..	..	..	282
1888	71	100	12	21	28	74	4	5	12	11	..	..	..	338
1889	79	99	14	30	29	91	9	5	12	14	6	..	..	388
1890	79	95	18	27	27	105	11	4	13	18	7	3	..	407
1891	81	104	17	33	23	108	11	5	19	28	9	3	..	441
1892	76	106	19	37	35	112	9	5	16	34	5	3	..	457
1893	78	97	22	50	39	141	4	10	19	31	10	2	8	511
1894	88	111	19	48	59	137	5	9	19	35	13	2	20	556*
1895	88	118	25	67	59	126	7	11	14	25	10	3	22	575
1896	99	117	24	65	66	106	7	11	11	34	8	..	25	573
1897	109	119	38	71	60	90	8	9	10	36	7	1	26	578*
1898	93	108	52	64	64	94	6	8	12	38	7	1	33	574*

* Deducting those counted twice.

The following table shows, by classes and by courses, the number of regular students who have registered themselves as electing to distribute the required studies and exercises over the period of five years:

Year.	Total.	Course.												
		I.	II.	III.	IV.	V.	VI.	VII.	VIII.	IX.	X.	XI.	XII.	XIII.
1st. .	4	..	..	..	..	..	..	..	..	..	..	..	..	..
2d . .	5	..	2	1	..	1	1	..	..	..	..	..	..	..
3d . .	5	1	1	..	..	1	1	..	..	1	..	..	..	..
4th. .	8	3	2	..	1	1	..	1	..	..	..	..	..	..
5th. .	4	..	2	..	1	1	..	..	..	..	..	..	..	..
	26	4	7	1	2	4	2	1	0	1	0	0	0	0

Classification of Special Students.

Our special students can, of course, not be classified systematically; but the following table exhibits the number of such students pursuing certain leading lines of study:

Applied Mechanics . . .	85	Language	171
Architecture	52	Mathematics	156
Biology	31	Mechanical Engineering .	79
Chemistry	115	Mining Engineering . .	19
Civil Engineering . . .	53	Naval Architecture . . .	6
Drawing	133	Physics	179
Electrical Engineering .	14	Political Science . . .	77
English	100	Sanitary Engineering . .	3
Geology	39	Shopwork	71
History	75		

The following is the number of students, either regular or special, pursuing certain leading branches of study, in each of the four years, as follows:

	First Year.	Second Year.	Third Year.	Fourth Year.	Total.
Mathematics . .	298	267	126	43	734
Chemistry . . .	353	63	103	71	590
English	302	247	32	1	582
French	162	88	48	..	298
Physics	...	284	301	169	754
German	74	187	173	8	442
Shopwork . . .	12	109	48	57	226

RESIDENCE OF STUDENTS.

STATES.	Candidates for Advanced Degrees.	Fourth Year.	Third Year.	Second Year.	First Year.	All Regular Students.	Special Students.	Total.
Alabama	..	..	..	..	..	..	1	1
California	..	2	3	1	2	8	3	11
Colorado	..	3	..	1	2	6	2	8
Connecticut	..	3	2	9	9	23	3	26
Delaware	..	1	..	1	..	2	1	3
Dist. of Columbia	..	1	..	1	2	4	4	8
Georgia	..	1	1	..	1	3	1	4
Hawaiian Islands	..	..	..	..	1	1	..	1
Illinois	..	7	10	8	13	38	13	51
Indiana	..	..	1	..	..	1	2	3
Iowa	..	4	2	1	..	7	..	7
Kentucky	..	2	1	2	3	8	2	10
Louisiana	..	..	..	1	.	1	..	1
Maine	..	3	6	3	3	15	4	19
Maryland	..	2	1	2	..	5	3	8
Massachusetts	7	106	119	126	187	545	174	719
Michigan	..	2	1	3	2	8	1	9
Minnesota	..	3	..	3	3	9	2	11
Missouri	..	2	1	1	4	8	2	10
Montana	..	..	..	1	..	1	1	2
Nebraska	..	..	1	..	..	1	..	1
New Hampshire	..	5	6	4	4	19	6	25
New Jersey	..	2	3	1	2	8	5	13
New York	..	4	11	11	14	40	28	68
North Carolina	..	..	1	1	..	2	..	2
Ohio	..	3	4	7	3	17	6	23
Oregon	..	..	..	..	1	1	2	3
Pennsylvania	..	8	7	4	3	22	12	34
Rhode Island	..	4	2	3	5	14	9	23
South Carolina	..	..	..	..	..	..	1	1
Tennessee	..	1	..	..	..	1	2	3
Texas	..	..	..	..	..	..	1	1
Utah	..	2	..	1	2	5	..	5
Vermont	..	2	1	2	5	10	2	12
Virginia	..	1	..	1	..	2	1	3
Washington	..	1	2	1	2	6	1	7
Wisconsin	..	1	..	1	3	5	3	8
Foreign Countries.								
Cape Breton	..	..	..	..	..	..	1	1
Cuba	..	1	..	..	..	1	..	1
Denmark	..	..	..	1	..	1	..	1
Dutch Guiana	..	..	1	..	..	1	..	1
England	..	1	1	..	2	4	..	4
France	..	..	..	..	..	..	1	1
Germany	..	..	..	..	1	1	..	1
Japan	..	..	1	..	..	1	..	1
Mexico	..	..	..	..	1	1	6	7
New Brunswick	..	2	..	..	1	3	..	3
Nova Scotia	..	1	..	..	..	1	1	2
Quebec	..	..	..	1	..	1	..	1
Turkey	..	..	..	1	1	2	1	3
Total	7	181	189	204	282	863	308	1171

Thirty-five States of the Union, besides the District of Columbia and the Hawaiian Islands, are represented on our list of students. Of the total number of 1,171, 719 are from Massachusetts, or 61.4 per cent. of the whole; 105 are from other New England States; 346 are from outside New England. Of these, 27 are from foreign countries.

A table showing the number of students in each year, from 1892, coming from each State or Territory, and from each foreign country, may not be without interest and instruction:

States.	1892.	1893.	1894.	1895.	1896.	1897.	1898.
Alabama	4	2	1	..	1	1	1
Arkansas	2	1	..	..	1	1	..
California	14	15	9	8	9	9	11
Colorado	7	5	8	7	7	8	8
Connecticut	27	30	29	27	24	30	26
Delaware	2	4	3	5	5	6	3
Dist. of Columbia	4	7	12	10	17	13	8
Florida	4	3	2	1	..	1	..
Georgia	3	3	2	2	3	4	4
Hawaiian Islands	2	2	.	..	..	..	1
Idaho	1	1	..	1	1	1	..
Illinois	40	39	36	42	45	40	51
Indiana	5	6	3	2	3	7	3
Iowa	10	13	10	12	14	12	7
Kansas	1	1	4	4	3	3	..
Kentucky	7	11	12	11	12	10	10
Louisiana	2	3	3	2	..	1	1
Maine	39	36	38	38	27	24	19
Maryland	6	4	4	9	9	8	8
Massachusetts	603	665	707	721	730	739	719
Michigan	10	7	8	7	6	5	9
Minnesota	13	11	9	5	7	8	11
Missouri	13	17	14	9	11	6	10
Montana	..	2	2	1	3	5	2
Nebraska	4	3	4	2	2	2	1
Nevada	3	2	2	..	.	..	..
New Hampshire	29	32	27	30	26	25	25
New Jersey	11	6	5	5	13	15	13
New Mexico	2	2	1	1	..	..	..
New York	50	52	59	64	69	62	68
North Carolina	1	..	..	..	1	1	2
Ohio	39	45	50	37	28	30	23
Oregon	2	1	1	1	4	3	3
Pennsylvania	25	31	37	36	42	41	34
Rhode Island	24	33	25	21	20	19	23
South Carolina	1	3	3	5	6	4	1
Tennessee	1	1	1	1	1	3	3
Texas	5	6	6	3	2	2	1
Utah	1	2	2	5	2	3	5
Vermont	4	5	3	5	7	11	12
Virginia	4	3	2	5	3	4	3
Washington	3	1	3	1	5	4	7
West Virginia	2	1	1	3	2	1	..
Wisconsin	9	11	6	7	6	6	8
Wyoming	..	..	..	..	1	..	..
Foreign Countries.							
Belgium	1	1	1	..	..	..	..
Brazil	..	..	1	1	..	..	..
Bulgaria	1	1	..	..	..	..	..
Cape Breton	..	..	..	..	..	..	1
Central America	1	1	..	1	..	..	..
Chile	..	..	1	1	1	..	..
Columbia	..	..	..	..	..	..	..
Cuba	..	1	1	3	2	1	1
Denmark	.	..	..	..	..	2	1
Dutch Guiana	..	..	..	..	..	..	1
England	1	1	..	2	2	2	4
France	1	1	..	..	1	1	1
Germany	..	2	1	..	..	..	1
Guatemala	1	.	..	..	..	..	..
Holland	2	2	2	..	..	..	..
Ireland	..	1	1	..	..	..	..
Japan	1	1	1	2	2	..	1
Mexico	1	1	1	1	3	6	7
New Brunswick	1	1	1	1	2	2	3
New South Wales	1	1	1	1	..	..	..
Nova Scotia	..	..	1	2	1	1	2
Ontario	2	4	4	2	2	..	..
Peru	..	..	..	..	..	..	..
Porto Rico	..	1	1	1	..	..	..
Quebec	5	5	2	2	2	2	1
Scotland	1	2	1	..	..	..	..
Spain	1	1	1	1	..	..	..
Trinidad	..	..	..	..	..	..	..
Turkey	1	..	1	3	1	3	3
Venezuela	..	1	1	1	1	..	..
Total	1060	1157	1183	1187	1198	1198	1171

Residence of Massachusetts Students.

It has been said that 61.4 per cent. of our students are from Massachusetts. All the counties of the State send students to the Institute. One hundred and twenty-two cities and towns are on the lists. The first column of the following table shows the number of cities and towns in each county

sending pupils; the second column gives the aggregate number from each county. It appears that Middlesex sends two hundred and thirty-three and Suffolk two hundred and fourteen pupils; Essex comes third, with ninety-nine; Norfolk, fourth, with sixty-five.

County.	No. of Towns.	No. of Students.	County.	No. of Towns.	No. of Students.
Barnstable . . .	5	6	Hampshire . . .	3	3
Berkshire	4	10	Middlesex . . .	34	233
Bristol	5	23	Norfolk	18	65
Dukes	1	1	Plymouth . . .	10	23
Essex	21	99	Suffolk	3	214
Franklin	5	5	Worcester . . .	9	22
Hampden . . .	4	15			
			Total	122	720

The following is a list of the towns, thirty-eight in number, which send four or more students to the Institute:

Boston . . .	200	Lawrence .	10	Fall River .	5
Newton . .	46	Lynn . . .	10	Lexington .	5
Cambridge .	35	Springfield .	10	Medford . .	5
Brookline . .	24	Winchester .	10	Quincy . .	5
Lowell . . .	23	Brockton .	9	Weston . .	5
Newburyport .	22	Hyde Park .	9	Worcester .	5
Somerville . .	18	Framingham	7	Andover . .	4
Malden . .	15	Haverhill .	7	Everett . .	4
Arlington . .	12	Melrose . .	7	Holyoke . .	4
Gloucester .	13	Waltham . .	7	Peabody . .	4
Chelsea . .	11	Fitchburg .	6	Pittsfield . .	4
New Bedford .	11	Natick . .	6	Taunton . .	4
Salem . . .	11	Canton . .	5		

The following table exhibits for ten years the distribution of the total number of students among two classes: First, those students whose names are found upon the Catalogue of the year preceding; and, secondly, those whose names appear first upon the Catalogue of the year to which the statement relates:

Year.	(1) Total No. of Students.	(2) No. of Students in the Catalogue of the previous year who remain in the Institute.	(3) No. of New Students entering before issue of Catalogue.	(4) Of those in column (3) the following number are regular First-year Students.	(5) No. of New Students not of the regular First-year Class.
1889–90	909	557	352	255	97
1890–91	937	572	365	234	131
1891–92	1,011	624	387	258	129
1892–93	1,060	618	442	303	139
1893–94	1,157	701	456	301	155
1894–95	1,183	768	415	271	144
1895–96	1,187	778	409	266	143
1896–97	1,198	758	440	263	177
1897–98	1,198	757	441	277	164
1898–99	1,171	769	402	278	124

Ages of Students on Entrance.

The next table exhibits the ages of our students upon entrance, after taking out three who are repeating the first year, and seven persons of unusual ages. These deductions

Period of Life.	1897–98.		1898–99.	
	Half-year Groups.	Yearly Groups.	Half-year Groups.	Yearly Groups.
16 to 16½ years	1	..	2	..
16½ to 17 "	1	2	5	7
17 to 17½ "	16	..	16	..
17½ to 18 "	33	49	32	48
18 to 18½ "	45	..	45	..
18½ to 19 "	39	84	51	96
19 to 19½ "	58	..	54	..
19½ to 20 "	25	83	28	82
20 to 20½ "	25	..	16	..
20½ to 21 "	9	34	10	26
21 to 22 "	9	9	13	13
	261	261	272	272

leave two hundred and seventy-two as the number of students whose ages have been made the subject of computation.

The results appear in the table above in comparison with the corresponding results of 1897–98.

From the foregoing it appears that the average age on entrance is eighteen years and eleventh months.

In this connection I present the ages, at graduation, of the class leaving us in June. The one hundred and ninety-eight members of the class were distributed among the different periods of life as follows:

Under 20½	2
Between 20½ and 21	13
" 21 " 21½	16
" 21½ " 22	22
" 22 " 23	67
" 23 " 24	38
" 24 and over	40
Total	198

The special students this year constitute twenty-six per cent. of the whole body, as against twenty-eight per cent. last year and twenty-seven per cent. the year before.

Graduates of Other Colleges.

The number of students who are graduates of this and other institutions is sixty-eight. Of these eleven are our own graduates, three being candidates for advanced degrees. Fifty-five are graduates of other institutions, pursuing courses of study with us either as regular or as special students. Twelve are graduates of Harvard University; four each of Yale University and Amherst College; three of Williams College; two each of Johns Hopkins, De Pauw, and Princeton Universities, and King's College, Windsor, N.S.; while the following institutions are represented on our list by a single graduate each: Brown, Chicago, Cornell, Georgetown, McGill, Michigan, Minnesota, Vermont, and Wisconsin Universities; Boston, Carleton, Central Turkey, Davidson, Doane, Hobart, Gonzaga, Iowa State Agricultural, Monmouth, New Hamp-

shire, R.I. Agricultural and Mechanic Arts, Robert, St. John's, Simpson, Smith, South Kentucky, and Vassar Colleges; Colegio de Carreras.

Women as Students at the Institute.

The number of women pursuing courses with us is forty-seven. Of these, two are graduates of colleges. Of the total number, three are regular students of the fourth year; four of the third year; five of the second year; five of the first year. Thirty are special students. Of the twelve regular students of the upper classes, three take Course IV., Architecture; four, Course V., Chemistry; one, Course VII., Biology; three, Course VIII., Physics; one, Course IX., General Studies. Of the special students, nine devote themselves to Biology, ten to Chemistry, four to Architecture, two to General Studies, one to Physics, one to Geology, two to Mathematics, and one to Drawing.

The diminution by twenty-two in the total number of women students is to be traced chiefly to the loss of twenty-one from the Biological Department. These are mostly special students, and were probably deterred from entering this year because of the removal of that department to the Pierce Building, which occasioned a delay of a month in preparation of the laboratories to receive students.

Statistics of Examinations.

Of the 1,171 students of the present year, 402 were not connected with the school in 1897–98. Of these, 269 were admitted as regular students of the first year upon the basis of their entrance examinations. The 133 remaining comprise (1) those who had previously been connected with the Institute, and have resumed their places in the school; (2) those who were admitted provisionally without examination; (3) those who were admitted by examination as regular second-year or as special students; (4) those who

were admitted on the presentation of diplomas or certificates from other institutions of college grade. In addition to the 269 who were thus admitted to the Institute on examination, and have taken their place in the school, 55 were admitted on examination, but have not entered the school.

In the case of the 269 persons who were admitted on examination, and have joined the school, the results of the examinations, embracing both those of June and those of September, were as follows:

Admitted clear	194
" on one condition	48
" on two conditions	20
" on more than two conditions	7
	269

Forty applicants were rejected.

Examinations at Distant Points.

In addition to the entrance examinations held at Boston in July and September, examinations were conducted in July at Albany, Belmont (Cal.), Buffalo, Chicago, Cincinnati, Cleveland, Concord (N. H.), Denver, Detroit, Easthampton (Mass.), Glens Falls (N. Y.), Kansas City (Mo.), Kingston (Pa.), Louisville, New York, Philadelphia, Pittsburgh, Portland (Me.), Portland (Oreg.), Pottstown (Pa.), Poughkeepsie, Springfield (Mass.), St. Louis, St. Paul, and Washington.

The following table exhibits the number of persons who have graduated within each of the several courses since the foundation of the school:

Year.	Civil Engineering.	Mechanical Engineering.	Mining Engineering.	Architecture.	Chemistry.	Metallurgy.	Electrical Engineering	Natural History or Biology.	Physics.	General Course.	Chemical Engineering.	Sanitary Engineering.	Geology.	Naval Architecture.	Total.
1868	6	1	6	..	..	..	..	..	..	1	..	..	..	..	14
1869	2	2	..	..	1	..	..	..	..	..	..	..	..	..	5
1870	4	2	2	..	1	..	..	..	..	1	..	..	..	..	10
1871	8	2	5	..	2	..	..	..	..	..	..	..	..	..	17
1872	3	1	5	..	3	..	..	..	..	..	..	..	..	..	12
1873	12	2	3	1	7	..	..	..	..	1	..	..	..	..	26
1874	10	4	1	1	..	..	..	..	..	2	..	..	..	..	18
1875	10	7	6	1	1	..	..	..	1	2	..	..	..	..	28
1876	12	8	7	..	5	1	..	2	3	4	..	..	..	..	42
1877	12	6	8	4	2	..	..	..	..	..	..	..	..	..	32
1878	8	2	2	3	3	..	..	..	..	1	..	..	..	..	19
1879	6	8	3	1	3	..	..	1	1	..	..	..	..	..	23
1880	3	..	3	..	1	..	..	..	..	1	..	..	..	..	8
1881	3	5	6	3	8	..	..	1	..	2	..	..	..	..	28
1882	2	5	5	3	6	..	..	1	1	1	..	..	..	..	24
1883	3	7	5	1	3	..	..	..	..	..	..	..	..	..	19
1884	5	6	13	..	12	..	..	..	..	..	..	..	..	..	36
1885	4	7	8	2	4	..	2	..	..	1	..	..	..	..	28
1886	9	23	7	1	7	..	10	1	..	1	..	..	..	..	59
1887	10	17	8	1	9	..	8	1	1	3	..	..	..	..	58
1888	11	25	4	5	10	..	17	3	1	1	..	..	..	..	77
1889	14	24	5	3	8	..	17	1	1	2	..	..	..	..	75
1890	25	27	3	5	13	..	18	3	2	6	..	..	..	..	102
1891	18	26	4	6	11	..	23	3	3	1	7	..	1	..	103
1892	22	26	4	13	7	..	36	6	1	7	4	6	1	..	133
1893	25	30	5	2	8	..	41	2	..	6	8	..	2	..	129
1894	21	31	4	14	11	..	33	1	3	5	12	3	..	..	138
1895	25	30	3	15	14	..	33	..	2	4	11	4	..	5	144*
1896	25	34	10	24	16	..	48	3	3	7	7	4	3	5	188*
1897	25	40	7	16	20	..	33	2	3	7	12	4	1	9	179
1898	32	41	7	29	23	..	33	3	4	6	9	3	..	7	197
Totals	375	449	159	154	219	1	352	34	30	73	70	24	8	26	1,971
Deduct names counted twice															11
Net total															1,960

* Deducting names counted twice.

SOCIETY OF ARTS.

BOSTON, June 30, 1898.

To the President of the Institute:

SIR: On behalf of the Executive Committee, I have the honor to present the annual report of the Society of Arts for the year 1897–98.

The first meeting of the year was held on October 28, no meeting being called for the 14th because the Corporation had arranged for a Memorial Meeting to be held on that date in honor of the late President Walker. In all, twelve meetings have been held, and the following papers have been read: "Recent Work in Heat Measurement at the Institute," by Mr. Charles L. Norton; "Cable and Underground Electric Roads," by Mr. Louis J. Hirt; "Contributions to our Knowledge of the Micro-organisms and Sterilizing Processes in the Canning Industries, II., The Souring of Sweet Corn," by Messrs. S. C. Prescott and W. Lyman Underwood; "The Concentration of Ores, with Special Reference to Recent Investigations on the Subject," by Prof. R. H. Richards; "A New System of Pneumatic Dispatch Tubes," by Mr. B. C. Batcheller; "The History and Present Development of the American Bicycle," by Dr. Leonard Waldo; "On Town, State, and City Boundaries," by Mr. Henry B. Wood; "Certain Sanitary Aspects of Jamaica," by Mrs. Ellen H. Richards and Mr. Arthur T. Hopkins; "On Fire-Proof Construction," by Dr. S. Albert Reed; "On the Constitution of Steel Considered as an Alloy of Iron and Carbon," by Mr. Albert Sauveur; and "The Economic Relations of Deep Inland Waterways to the State of New York," by Mr. George W. Rafter.

The membership of the Society of Arts continues to increase, although there have not been added so many new

members as during the previous year. At the close of the year 1896–97 the number of life members was 59; 6 have died since then, leaving the present number 53. The number of associate members a year ago was 311; of these, 1 has died and 9 have resigned. These losses are offset by the election during the year of 22 associate members, making the total number 323.

Early in the autumn the Executive Committee lost one of its members by the death of Mr. Thomas Doane, who was distinguished as an engineer and as the founder of Doane College in Nebraska. He had been connected with the Society as a life member for many years. The other life members who died during the year are John M. Forbes, Joseph S. Fay, John Lowell, Theodore Lyman, and Jacob Norton. We have lost one associate member by death, Mr. C. H. Parker, of Cambridge.

A notable event in the history of the Society of Arts was the election of Professor James M. Crafts to be President of the Institute. He was introduced to the Society as its President at the meeting of October 28th.

An Amendment to the By-Laws of the Society of Arts was adopted by the Society December 9, with the approval of the Corporation. This amendment provides that three members shall constitute a quorum of the Executive Committee for the transaction of business.

The Board of Publication, which has charge of the "Technology Quarterly" and "Proceedings of the Society of Arts," was reappointed, with the exception of Prof. Henry M. Howe, who has removed to New York, Prof. Charles R. Cross being chosen in his place. The following members now constitute the Board of Publication, viz.: Prof. W. T. Sedgwick, Chairman, Prof. Charles R. Cross, Prof. Dwight Porter, A. Lawrence Rotch, Esq., and the Editor, Dr. R. P. Bigelow.

From 1880 to 1891 the Society of Arts published an annual volume of "Proceedings." The "Technology Quarterly" was founded in 1887 by the students, and was published by a

board of editors chosen from the junior and senior classes, William S. Hadaway, Jr., '87, being the first editor-in-chief. Two years later Mr. James P. Munroe became the sole editor, under the auspices of the Faculty, and in 1892 the control of the journal was transferred to the Society of Arts and it was united then with the "Proceedings." Thus it became an official organ of the Institute. By a vote of the Society, the Executive Committee was authorized to appoint annually a Board of Publication to exercise a general control and supervision over the "Quarterly." The active management, however, falls upon the editor, who is appointed by the Executive Committee upon nomination by the Board of Publication.

During the present year the "Technology Quarterly" has published not only the minutes of proceedings of the Society and a number of papers read at its meetings, but it has contained also a number of original articles, which have been presented to the Society by title only. The series of results of tests made in the Engineering Laboratories has been continued, as well as the Review of American Chemical Research.

The last meeting of the year was the 36th annual meeting of the Society of Arts. At this meeting Messrs. George W. Blodgett, Desmond FitzGerald, Edmund H. Hewins, Frank W. Hodgdon, and Charles T. Main, were elected members of the Executive Committee, and Mr. Arthur T. Hopkins was elected Secretary for the year 1898–99.

Respectfully submitted,

ROBERT P. BIGELOW,

Secretary.

LOWELL SCHOOL OF DESIGN.

The Lowell School of Design has a satisfactory report to make of the year's work. The number of students is limited to forty-two, and it is intended to open the class only for those who are thoroughly prepared to take the work. The students are diligent and take an intelligent interest in their pursuits, and coöperate with the director in maintaining a high standard of work. The accounts received from mill superintendents and others, employers of those students, who, since the opening in 1872, have received their education at this school, lead us to believe that the demands for a professional education of designers have been well understood and met. The embroidery designs, water colors, and decorated china made by the female students find a ready sale.

TREASURER'S REPORT.

STATEMENT OF THE TREASURER.

THE Treasurer submits the annual statement of the financial affairs of the Institute for the year ending Sept. 30, 1898.

The past year has been a remarkable one in the financial history of the Institute. More money has been received through bequests and gifts than in any previous year. Under the will of the late Hon. Henry L. Pierce seven hundred and fifty thousand dollars have been paid to the Institute by his executors. This is the largest sum ever given to it by any one person. In addition to this the executors of the late Mrs. Julia B. Huntington James have paid over the very notable sum of one hundred and forty thousand five hundred dollars. This is also one of the largest gifts ever made to the Institute.

George A. Gardner, Esq., has generously given twenty thousand dollars as a fund, the income from which is to be used in the payment of salaries, a purpose for which money is much needed. Ten thousand dollars have come from the estate of the late John Foster, and sixty-two hundred and fifty dollars from that of the late John W. Carter, and fourteen hundred and eighty-two dollars and seventy-nine cents have been added to the sum previously received from the estate of the late Mrs. Susan E. Dorr for the Rogers Physical Laboratory.

Besides these gifts to the Institute itself a Travelling Fellowship in the Architectural Department has been established by the will of Willard B. Perkins. For this purpose the sum of six thousand dollars has been given, the accumulated income from which is to be used every fourth year.

Forty thousand dollars have come from the estate of the late Mrs. Ann White Dickinson, the whole sum for scholarship purposes.

A friend has given five hundred dollars to meet a special want, and two hundred dollars have come from Mrs. William B. Rogers, to be used for periodicals.

This great increase in funds came at a time when it was very much needed. It led at once to the erection of the new fireproof building in Trinity place, which is to bear the name of the late Hon. Henry L. Pierce. It has also made possible extensive changes and improvements in the old buildings.

In current expenses there has been a saving in fuel, water, gas, electricity, printing, interest, and expenses of the Society of Arts, amounting in all to nearly seven thousand dollars. This saving, however, has been much more than offset by an increase of about nine thousand dollars in salaries, sixteen thousand in repairs, and three thousand in general expenses.

The result is an adverse balance of more than seven thousand dollars in current expense account. It must, however, be borne in mind that all payments made for the extensive alterations and improvements in the old buildings have been charged to repair account. The increase of sixteen thousand dollars in the repair account is due to these changes. Next year we need not expect any such expenditure as this, but we shall have the increased expense involved in the use of the new building.

During the year the debt has been reduced from a hundred and twenty thousand dollars to twenty thousand. About a hundred thousand dollars have been paid on account of the new building, and there have been deducted from the bond premium account more than thirty-four hundred dollars.

In addition to the payment of the above note, the property of the Institute, after deducting insurance money which will be required for restoring the buildings damaged by fire, has been increased by eight hundred and sixty-seven thousand two hundred and forty-six dollars and ninety-nine cents.

Securities Sold or Paid, General Account.

$1,000	Bur. & Missouri River R.R. 6s., 1918	1,000.00
3,000	Chi., Milwaukee & St. Paul R.R. $7\frac{8}{10}$s., 1898	3,000.00
3,000	Am. Bell Telephone 7s., 1898	3,000.00
16	Rights Boston Real Estate Trust	216.00
		7,216.00

Securities Bought or Received as Legacies, General Account.

$1,000	Bur. & Missouri River R.R. non-exempt 6s.,	1918	1,080.00
3,000	Chi., Milwaukee & St. Paul R.R. 7s.	1905	4,140.00
3,000	Am. Bell Telephone 7s.	1898	3,000.00
46,000	Chi. Junct. & Union Stock Yards 5s.	1915	51,340 00
5,000	Dominion Coal Co. 1st. 6s.	1913	5,150.00
2,000	Low., Law. & Haverhill St. Ry. 5s.	1923	2,020.00
2,000	New England Tel. & Tel. Co. 6s.	1907	2,160.00
2,000	N. Y. & New England R.R. 7s.	1905	2,340.00
21,000	N. Y. & New England R.R. 6s.	1905	23,220.00
100,000	West End Street Ry. 4s.	1917	104,000.00
50,000	Utah & Northern R.R. 1st. 7s.	1908	60,875.00
150,000	Walter Baker Co. Ltd. $4\frac{1}{2}$s.	1903	150,000.00
50 Sh.	Boston & Albany R.R.		10,750.00
50 "	N. Y., New Haven & Hartford R.R.		9,000.00
50 "	Boston & Maine R.R., common		8,300.00
25 "	Boston & Providence R.R.		6,625.00
55 "	Chi., Burlington & Quincy R R.		5,225.00
50 "	Chi., Mil. & St. Paul R.R., Pf.		7,000.00
50 "	Chi., Rock Island & Pacific R.R.		4,350.00
50 "	Fitchburg R.R., Pf.		4,800.00
55 "	New England Tel. & Tel. Co.		6,755.94
50 "	American Bell Telephone Co.		12,750.00
60 "	Pullman's Palace Car Co.		10,200.00
23 "	Boston Real Estate Trust		26,128.00
			521,208.94

GEORGE WIGGLESWORTH, TREASURER, *in account with*
GENERAL STATEMENT OF RECEIPTS AND DISBURSEMENTS

Dr.

Cash balance Sept. 30, 1897		35,962.67
From Augustus Lowell for Lowell Courses	5,700.00	
" " " " C. Kastner's salary	2,500.00	
" " " " School of Design	500 00	
		8,700.00
RECEIPTS FOR CURRENT EXPENSES.		
Income of funds for salaries	3,504.00	
" " " " scholarships (students' fees)	7,325.00	
" " " " Joy "	150.00	
" " " " Swett "	400.00	
" " " " Savage "	400.00	
" " " " Library	480.00	
" " " " general purposes	12,494.60	
" " Rogers Memorial Fund	10,949.00	
" " Charlotte B. Richardson Fund	1,495.15	
" " Rotch Prize Fund used 1897	450.00	
Letter Box Fund used 1897 [46.50]	125.00	
Students' fees	216,832.00	
State Scholarships	4,000.00	
U. S. Grant of 1862	5,131.37	
U. S. Grant of 1890	8,000.00	
Gift of State of Massachusetts	25,000.00	
Laboratory supplies and breakages	8,863.02	
Rents, per Table (page 94)	11,318.99	
Gifts	700.00	
Interest	9,673.03	
Boston University	1,150.00	
Sale printed Lecture Notes	2,593.87	
		331,035.03
GIFTS AND BEQUESTS FOR SPECIAL PURPOSES.		
Increase James Savage Fund	121.25	
" Dalton Graduate Scholarship Fund	212.76	
" Joy Fund	50.00	
" W. B. Rogers Fund [additional]	300.00	
Susan E. Dorr Fund [" 1,482.79]	1,662.79	
Ann White Dickinson Fund ["]	40,000.00	
Rotch Prize Fund	400.00	
Willard B. Perkins Fund	6,080.00	
Geo. A. Gardner Fund	20,000.00	
		68,826.80
GIFTS AND BEQUESTS FOR GENERAL PURPOSES.		
John Foster Legacy	10,000.00	
Henry L. Pierce Legacy	750,000.00	
John W. Carter Legacy	6,250.00	
James Fund	140,500.00	
		906,750.00
SECURITIES SOLD OR PAID. GENERAL FUND, page 85		7,216.00
SUNDRIES.		
Income credited to Bond Premium Acct.	2,920.51	
Income credited to Rogers Bond Premium Acct.	500.00	
Boston Art Students' Association on acc't	666.67	
Students' Notes paid	440.00	
Insurance, Engineering Building	27,979.20	
		32,506.38
		$1,390,996.88

MASSACHUSETTS INSTITUTE OF TECHNOLOGY.
FOR THE YEAR ENDING SEPTEMBER 30, 1898.

Cr.

Paid for Lowell Courses	5,700.00	
" " Charles Kastner's salary	2,500.00	
" " Expense Lowell School of Design	500.00	
		8,700.00
EXPENSES.		
Salaries, per Table (page 94)	231,955.72	
" paid from Gifts	500.00	
Fellowship paid from Swett Fund	400.00	
" " " Savage "	400.00	
Prizes, Rotch Funds	450.00	
Repairs, per Table (page 95)	27,206.89	
General Expenses, per Table (page 95)	17,245.67	
Fuel	5,360.16	
Water	1,810.40	
Gas	2,060.90	
Electricity	882.42	
Printing and Advertising	2,764.12	
" Lecture Notes	1,306.16	
" Annual Catalogues and Reports	2,313.82	
Rents paid Boston & Albany R.R. Co.	180.00	
" " Natural History Society	200.00	
Laboratory Supplies and Libraries, per Table (page 94)	34,784.05	
Society of Arts	593.31	
Interest allowed on funds not in Bonds and Stocks, at 4 per cent.	2,476.17	
Interest paid A. Lowell, Trustee	1,000.00	
" " on Mortgage Notes	2,000.00	
Mech. Eng. & Applied Mechanics Department Improvements	500.00	
Memorial of Francis A. Walker	1,453.67	
Omaha Exposition	326.62	
		338,170.08
[Expenses more than Income, $7,135.05]		
SECURITIES BOUGHT OR RECEIVED AS LEGACIES. GENERAL ACCOUNT, page 85		521,208.94
Pierce Building, Trinity Place, on acct.		99,638.90
Fire Repairs, Engineering Building		7,383.27
" " " Contents		4,133.30
SUNDRIES.		
Notes Payable	100,000.00	
Notes Receivable	200,000.00	
Students' Deposits	100.00	
Funds of 1897, used	1,094.76	
		301,194.76
Cash balance, Sept. 30, 1898		110,567.63
		$1,390,996,88

The following account exhibits the property held by the Institute, as per Treasurer's books, Sept. 30, 1898:

INVESTMENT OF THE W. B. ROGERS MEMORIAL FUND.

$30,000.00	Burlington & Mo. River R.R. 4s. .	1910	25,787.50	
27,000.00	Kansas City Belt R.R. 6s.	1916	27,000.00	
16,000.00	Kansas City, Cl. & Springfield R.R. 5s.	1925	16,000.00	
6,000.00	New York & New England R.R. 6s.	1905	6,000.00	
5,400.00	Republican Valley R.R. 6s. . . .	1919	5,400 00	
4,000 00	Cin., Ind., St. Louis & Chicago R.R. 6s.	1920	4,000.00	
2,000 00	Ottawa, Oswego & Fox River R.R. 8s.	1900	2,000.00	
2,000.00	Kansas City, Fort Scott & Gulf R.R. 7s.	1908	2,000.00	
3,000.00	Kansas City, Memphis & Birmingham R.R.			
	1,000 General Mortgage 4s. . . .	1934	2,221.40	
	2,000 Income 5s.	1934		
1,000.00	Lincoln & Northwestern R.R. 7s. .	1910	1,000.00	
1,000.00	Atchison & Nebraska R.R. 7s. . .	1908	1,000.00	
42,000.00	Chi., Bur. & Quincy R.R. Conv. 5s. .	1903	40,820.00	
35,000.00	Fort Street Union Depot 4½s. . . .	1941	34,825.00	
24,000.00	Rome, Watertown & Ogdensburg R.R. 5s.	1922	24,000.00	
37,500.00	Detroit, G. Rapids & Western R.R. 4s.	1946	37,500.00	
	255 Shares Detroit, Grand Rapids & Western Pfd., par 100		12,500.00	
	Advance to Bond Premium account .		7,400.00	
	Bonds and Stocks			249,453.90

INVESTMENTS, GENERAL ACCOUNT.

$14,000.00	Bur. & Mo. River (Neb.) R.R. 6s., non-exempt	1918	14,000.00	
2.000.00	Bur. & Mo. River (Neb.) R.R. 6s., exempt	1918	2,000.00	
6,000.00	Chicago, Burlington & Quincy R.R. 4s.	1922	5,100.00	
3,000.00	Chicago, Mil. & St. Paul R.R. 7s .	1905	3,000.00	
4,000.00	Chicago, Burlington & Northern R.R. 5s.	1926	4,000.00	
2,000.00	Kansas City, Fort Scott & Gulf R.R. 7s.	1908	2,000.00	
3,000 00	Hannibal & St. Joseph R.R. 6s. . .	1911	3,000.00	
15,000.00	Chi., Bur. & Quincy R.R. Conv. 5s. .	1903	15,000.00	
6,000.00	West End Street Ry. 5s	1902	6,000.00	
2,000.00	Brookline Gas Light Co. 5s. . . .	1913	2,000.00	
35,000.00	Fitchburg R.R. 5s.	1903	35,000.00	
65,000.00	Boston & Maine R.R. 4½s.	1944	65,000.00	
26,000.00	Am. Dock & Improvement Co. 5s. .	1921	26,000.00	
3,000.00	Illinois Central R.R. 4s.	1951	3,000.00	
26,000.00	New York & New England R.R. 6s.	1905	26,000.00	
46,000.00	Chic. Junc. & Union Stock Yards 5s.	1915	46,000.00	
5,000.00	Dominion Coal Co. 1st. 6s. . . .	1913	5,000.00	
2,000.00	Low., Law. & Haverhill St. Ry. 5s. .	1923	2,000.00	
2,000.00	New England Tel. & Tel. Co. 6s. .	1907	2,000.00	
2,000.00	New York & New England R.R. 7s.,	1905	2.000.00	
100,000.00	West End Street Ry. 4s	1917	100,000.00	
50,000.00	Utah & Northern R.R. 1st. 7s. . .	1908	50,000.00	
150,000.00	Walter Baker Co. Lt'd. 4½s . . .	1903	150,000.00	
	Advances to Bond Premium account		26,526.43	
	Bonds			594,626.43
	Amount carried up			$844,080.33

Amount brought up				844,080.33

STOCKS.

SHARES.				
198	Boston & Albany R.R.	par 100	40,683.00	
194	Morris & Essex R.R.	" 50	14,690.00	
40	New York & Harlem R.R.	" 50	5,000.00	
85	Pittsburg, Fort Wayne & C. R.R.	" 100	12,880.00	
100	N.Y., New Haven & Hartford R.R.	" 100	17,000.00	
50	Boston & Maine R.R. common	" 100	8,300.00	
25	Boston & Providence R.R.	" 100	6,625.00	
55	Chi., Bur. & Quincy R.R.	" 100	5,225.00	
50	Chi., Milwaukee & St. Paul R.R. Pf.	" 100	7,000.00	
50	Chi., Rock Island & Pacific R.R.	" 100	4,350.00	
50	Fitchburg R.R. Pf.	" 100	4,800.00	
60	Pullman's Palace Car Co.	" 100	10,200.00	
12	Cocheco Manufacturing Co.	" 500	6,000.00	
56	Hamilton Woollen Co.	" 100	5,390.00	
59	Everett Mills	" 100	5,310.00	
31	Great Falls Manufacturing Co.	" 100	3,472.00	
6	Manchester Mills	" 100	660.00	
2	Dwight Manufacturing Co.	" 500	1,600.00	
1	Merrimack Manufacturing Co.	" 1000	1,015.00	
1	Laconia Co.	" 400	605.00	
2	Pepperell Manufacturing Co.	" 500	2,300.00	
10	Lowell Bleachery	" 100	975.00	
27	Essex Co.	" 50	3,780.00	
158	Pennsylvania Coal Co.	" 50	23,160.50	
15	Consolidated Gas Co., New York	" 100	1,447.50	
7	Lowell Gas Light Co.	" 100	1,610.00	
40	Cambridge Gas Light Co.	" 100	7,000.00	
7	Lawrence Gas Light Co.	" 100	882.00	
55	Old Boston National Bank	" 100	5,510.50	
15	Merchants' National Bank	" 100	2,220.00	
25	New England National Bank	" 100	3,875.00	
25	Atlantic National Bank	" 100	2,875.00	
10	National Union Bank	" 100	1,240.00	
25	National Bank of the Republic	" 100	3,625.00	
40	The Molsons Bank, Montreal	" 50	3,000.00	
37	Nat. Mechanics Bank, Baltimore	" 10	706.70	
10	First Nat. Bank of Baltimore	" 100	1,293 30	
39	Boston Real Estate Trust	" 1000	44,212.00	
1	Boston Ground Rent Trust	" 1000	900.00	
50	American Bell Telephone Co.	" 100	12,750.00	
55	New England Tel. & Tel. Co.	" 100	6,755.94	
				290,923.44

INVESTMENT OF THE JOY SCHOLARSHIP FUND.

Massachusetts Hospital Life Insurance Co. .	5,000.00	
Deposits in Savings Banks	4,123 70	
		9,123.70

INVESTMENT SWETT SCHOLARSHIP FUND.

Massachusetts Hospital Life Insurance Co.	10,000.00
Amount carried up	$1,154,127.47

Amount brought up			1,154,127.47
REAL ESTATE.			
Rogers Building		200,000.00	
Walker "		150,000.00	
Land on Garrison Street	50,840.00		
Workshops " "	30,000.00		
		80,840.00	
Land on Trinity Place	76,315.69		
Engineering Bldg., Trinity Place	90,000.00		
		166,315.69	
Gymnasium Building		7,967.85	
Architectural "		57,857.10	
Lot No. 2, Trinity Place		137,241.60	
Pierce Building, Trinity Place		99,882.47	
Clarendon St. Land and Building		142,762.94	
House No. 34 Commonwealth Ave.		30,000.00	
Real Estate, Massachusetts Ave., Cambridge		16,154.38	
			1,089,022.03
Equipment, Engineering Building		16,555.24	
" Workshops		20,628.56	
			37,183.80
SUNDRIES.			
Notes Receivable		278,500.00	
Boston Art Students' Association		11,666.66	
Students' Notes		1,405.50	
Cash Balance, Sept. 30, 1898		110,567.63	
			402,139.79
			$2,682,473.09

The foregoing property represents the following Funds and Balances, and is answerable for the same.

The income of the following is used for the general purposes of the Institute:

William Barton Rogers Memorial Fund	250,225.00	
Richard Perkins Fund	50,000.00	
George Bucknam Dorr Fund	49,573.47	
Martha Ann Edwards "	30,000.00	
Nathaniel C. Nash "	10,000.00	
Sidney Bartlett "	10,000.00	
Robert E. Rogers "	7,680.77	
Albion K. P. Welch "	5,000.00	
Stanton Blake "	5,000.00	
McGregor "	2,500.00	
Katharine B. Lowell "	5,000.00	
Samuel E. Sawyer "	4,610.87	
John W. and Belinda Randall Fund	50,000.00	
James Fund	140,500.00	
		620,090.11
Amount carried up		$620,090.11

Amount brought up		620,090.11
The income of the following is used towards paying salaries:		
Nathaniel Thayer, for Professorship of Physics	25,000.00	
Jas. Hayward, for Professorship of Engineering	18,800.00	
William P. Mason " Geology	18,800.00	
Henry B. Rogers, for General Salaries	25,000.00	
George A. Gardner, " "	20,000.00	
		107,600.00
SCHOLARSHIP TRUSTS.		
Richard Perkins Fund	53,209.82	
James Savage Fund	13,552 45	
Susan H. Swett Fund	10,182.95	
William Barton Rogers Fund	10,878.29	
Joy Fund	9,173.70	
Elisha Thatcher Loring Fund	5,329.39	
Charles Lewis Flint Fund	5,253.93	
Thomas Sherwin Fund	5,000.00	
Farnsworth Fund	5,000.00	
James H. Mirrlees Fund	2,796.19	
William F. Huntington Fund	5,208.33	
T. Sterry Hunt Fund	3,221.46	
Elisha Atkins Fund	5,000.00	
Nichols Fund	5,000.00	
Ann White Vose Fund	60,726.82	
Ann White Dickinson Fund	40,000.00	
Dalton Fund	5,531.81	
Willard B. Perkins Fund	6,080.00	
		251,145.14
OTHER TRUSTS.		
Charlotte Billings Richardson, Industrial Chemistry Fund		37,378.78
Susan Upham Fund		1,245.97
Susan E. Dorr Fund		5,420.59
William Hall Kerr, Library Fund		2,000.00
Biological Instrument Fund		143.50
Charles Lewis Flint, Library Fund		5,000.00
Rotch Architectural Library Fund		5,000.00
Rotch Architectural Fund		25,000.00
Rotch Prize Fund		5,200.00
Rotch " Special " Prize Fund		5,200.00
Letter-box Fund, balance		63.87
MISCELLANEOUS.		
Notes Payable	20,000.00	
Students' Deposits	150.00	
Fire Insurance, Engineering Building	16,462.63	
Moses Kimball Legacy, 1896	5,000.00	
Benjamin P. Cheney Legacy, 1896	10,000 00	
Susan G. Coolidge Devise, 1896	14,500.00	
John Foster Legacy, 1898	10,000.00	
Henry L. Pierce Legacy, 1898	750,000.00	
John W. Carter Legacy, 1898	6,250.00	
M.I.T. Stock Account	779,622.50	
		1,611,985.13
		$2,682,473.09

Comparative Statement of Funds, etc.

	Sept. 30, 1897.	Sept. 30, 1898.
Trusts for general purposes	479,590.11	620,050.11
" " Salaries	87,600.00	107,600.00
" " Scholarships	204,979.23	251,145.14
" " Library	7,000.00	7,000.00
Charlotte B. Richardson Ind. Chem. Fund	37,378.78	37,378.78
Susan Upham Fund	1,246.13	1,245.97
Susan E. Dorr Fund	3,757.80	5,420.59
Rotch Architectural Library Fund	5,000.00	5,000.00
Rotch Architectural Fund	25,000.00	25,000.00
Rotch Prize Fund	5,225.00	5,200.00
Rotch "Special" Prize Fund	5,225.00	5,200.00
Catherine P. Perkins Legacy	102,781.40	
Henry C. Hutchins "	2,000.00	
Moses Kimball "	5,000.00	5,000.00
Benj. P. Cheney "	10,000.00	10,000.00
John Foster "		10,000.00
Henry L. Pierce "		750,000.00
John W. Carter "		6,250.00
Susan G. Coolidge Devise	14,500.00	14,500.00
Letter-box Fund	110.37	63.87
Biological Instrument Fund	143.50	143.50
Students' Deposits	250.00	150.00
Notes Payable	120,000.00	20,000.00
Fire Insurance, Engineering Building		16,462.63
M.I.T. Stock Account	681,976.15	779,622.50
	$1,798,763.47	$2,682,473.09
Increase		
Consisting of:		
Bequests for Special Purposes, etc. See page 86		68,826.80
Gifts and Bequests for General Purposes. See page 86		906,750.00
Fire Insurance		16,462.63
		992,039.43
Less Notes Payable Paid	100,000.00	
" Funds of 1897 used	1,094.76	
" Students' Deposits	100.00	
" Expenses more than Income	7,135.05	
		108,329.81
		$883,709.62

INCOME FROM GENERAL INVESTMENTS, AND APPLICATION THEREOF.

Applied to Salaries	3,504 00	From Dividends, Bank Stocks	1,080.00
" " Scholarships	6,726 74	" State Tax returned on Bank Stocks	228.94
" " " James Savage Fund	400.00	" Bonds	15,410.38
" " Charlotte B. Richardson Fund	1,495.15	" Dividends, Railroad Stocks	5,608.00
" " Rotch Prize Funds	400.00	" " Coal and Gas Stocks	1,980.00
" " Library	480.00	" " Manufacturing Stocks	902.00
" " General Purposes	12,454.60	" Telephone Stocks	540.00
" " Increase of Funds	594.01	" Real Estate Stocks	789.52
" " Advances to Bond Premiums	2,920.51	" Interest allowed on Funds not in Bonds and Stocks @ 4%	2,476.17
	$29,015.01		$29,015.01

INCOME FROM WILLIAM BARTON ROGERS MEMORIAL FUND, AND APPLICATION THEREOF.

Paid Massachusetts Institute of Technology	10,949 00	Received Income from Railroad Bonds	11,449.00
Credited to Advances Bond Premiums	500.00		
	$11,449.00		$11,449.00

DETAILS OF SOME ITEMS IN TREASURER'S CASH ACCOUNT.

Rents.

Huntington Hall, for Lowell Lectures		3,500.00	
Lowell School of Design		1,800.00	
Chauncy Hall School, for Gymnasium		75.00	
Land and Building, Clarendon St., on account		4,000.00	
34 Commonwealth Avenue, 1 year	2,200.00		
less Annuity under Will	1,000.00		
less Tax	360.10		
	1,360.10		
		839.90	
Use of Rooms and Gymnasium		1,393.79	
		11,608.69	
less Tax and Repairs, Cambridge		289.70	
			11,318.99

Department Supplies.

Civil Engineering	2,738.52	
Mechanical Engineering	2,903.32	
Applied Mechanics	1,639.91	
Mining	2,380.94	
Architecture	2,652.15	
Chemistry	8,944.39	
Physics	6,127.90	
Biology	1,127.87	
English	928.58	
Modern Languages	90.35	
Geology	515.66	
Naval Architecture	590.66	
Drawing	100.51	
Mathematics	103.89	
Military	104.25	
Periodicals	1,861.23	
Workshops	1,973.92	
		34,784.05

Salaries.

Instruction	186,170.02	
Administration	24,266.88	
Labor	21,518.82	
		231,955.72

General Expenses.

Fire Insurance		2,941.63	
Stationery and Office Supplies		2,164.58	
Furniture		2,201.87	
Electric Wiring		2,162 05	
Postage		1,612.51	
Janitor's Supplies: Brushes, Paints, etc.		801.20	
Entrance Examinations		723.83	
Express Charges, Teaming, etc.		636 96	
Sundries		614.37	
Diplomas		587.40	
Washing		519.44	
Engine Room Supplies:			
Oil	242.29		
Cotton Waste	44.18		
Sundries	37.24		
		323.71	
Ice		255.36	
Glass		206 99	
Books, Supplies, etc., for General Library		179.29	
Lowell School of Design		161.74	
Window Shades		159.35	
Paints, Varnish, etc.		152.52	
Graduation Exercises		149.85	
Type-writing Machine		102.50	
Examination Books		100.00	
Raffle Plates for Boiler		100.00	
Blackboards		99.16	
Telephone & Telegraph Co.		94.24	
Gymnasium Supplies		93.12	
Union Deposit Vaults		75.00	
Western Union Telegraph Co.		27.00	
			17,245.67

Repairs.

Department Improvements:			
Civil Engineering	126.29		
Mechanical Engineering	1,037.45		
Applied Mechanics	126.20		
Mining	2,447.23		
Architecture	304.13		
Chemistry	4,050.33		
Physics	889.08		
Biology	16.25		
English	7.73		
Geology	123.75		
Naval Architecture	263.67		
Drawing	40.53		
Military	2.30		
Workshops	1,217.71		
		10.652.65	
Sundries		6,212.13	
Rogers Building		5,825.10	
Walker Building		1,662.94	
Steam Fitting		741.25	
Architectural and Engineering Buildings		612.36	
Gymnasium		435.28	
Boilers, Tools, etc.		264.80	
Huntington Hall		233.90	
Ventilation Engineering Laboratory		224.55	
Lawn Tennis Court		216.93	
Deane Steam Pump		125.00	
			27,206.89

BOSTON, December 7, 1898.

An examination of the accounts of the Treasurer of the MASSACHUSETTS INSTITUTE OF TECHNOLOGY for the year ending September 30, 1898, has been made by Mr. E. A. Stone, an accountant employed by this committee. We have also verified the evidences of personal property held by the Institute.

The report of Mr. Stone is hereto annexed.

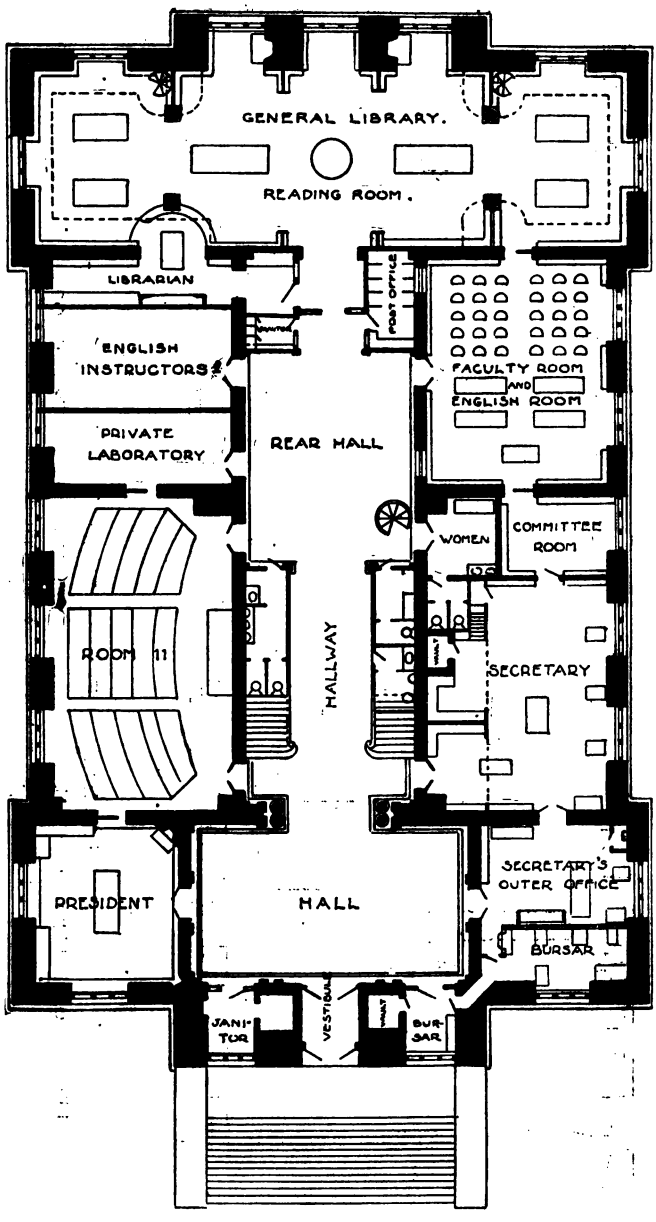
JAMES P. TOLMAN,
CHARLES C. JACKSON,
WILLIAM L. PUTNAM,
} *Members of the Auditing Committee.*

BOSTON, December 7, 1898.

To the Auditing Committee of the
Massachusetts Institute of Technology:

GENTLEMEN: I have completed the examination of the Treasurer's accounts for the year ending September 30, 1898, and find them to be correct. I have also verified the bank balances. The trial balance corresponds with the ledger balances. I have also examined the vouchers, and find receipts for all items, except the amounts paid out on the weekly pay-roll, and these amounts correspond with the pay-roll.

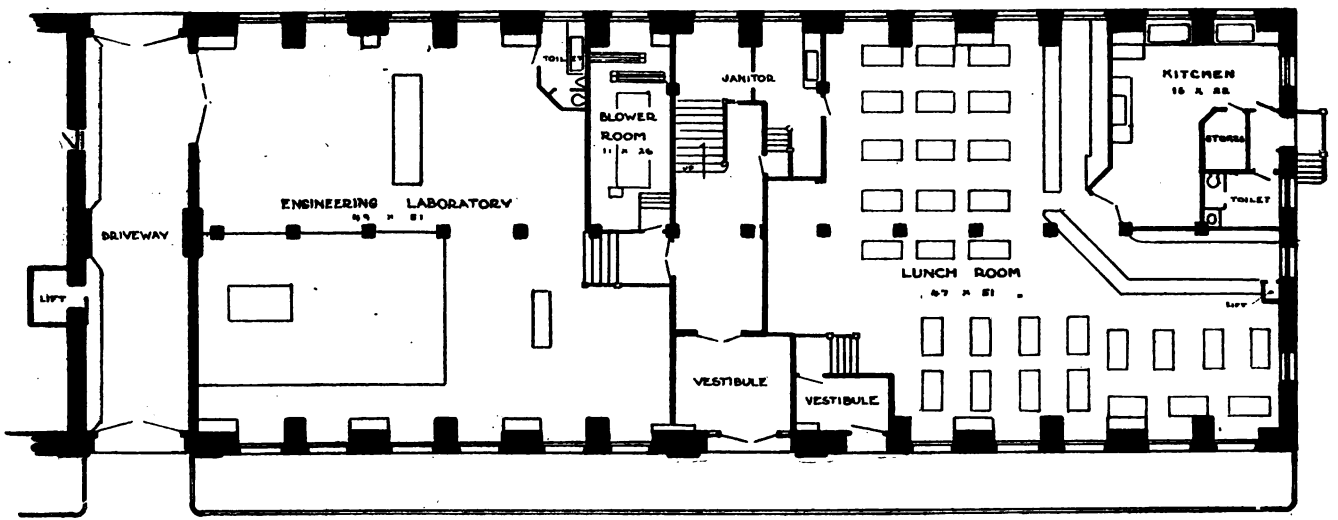
Yours truly,
EDWIN A. STONE,
Accountant.



ALTERATIONS IN ROGER'S BUILDING

ELEAZER B HOMER: ARCHITECT.

PIERCE BUILDING



BASEMENT FLOOR PLAN

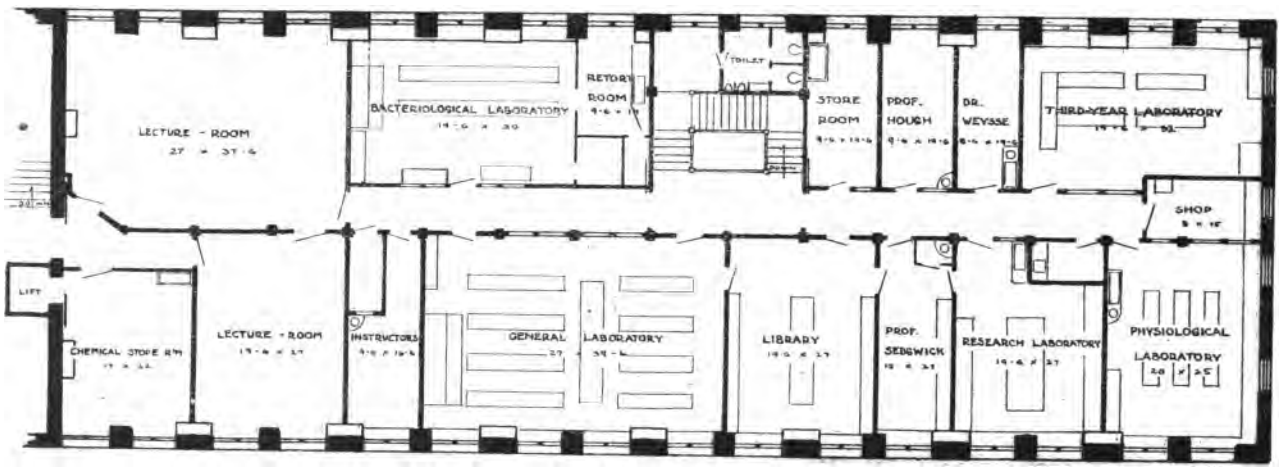
FIRE-PROOF BUILDING OF THE MASSACHUSETTS INSTITUTE OF TECHNOLOGY

ELEAZER B. HOMER. ARCHITECT.

PIERCE BUILDING

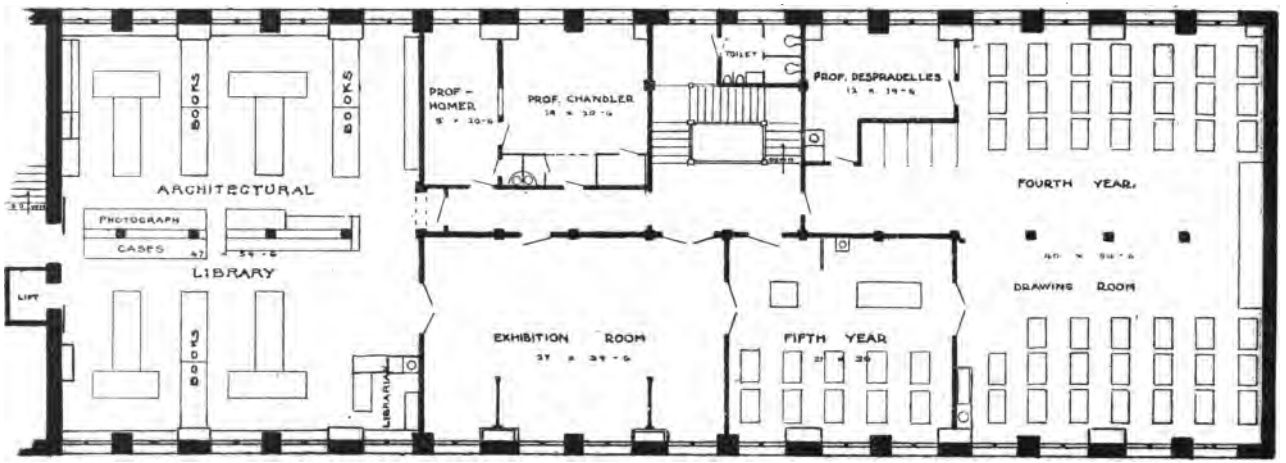
FIRST FLOOR PLAN

PIERCE BUILDING



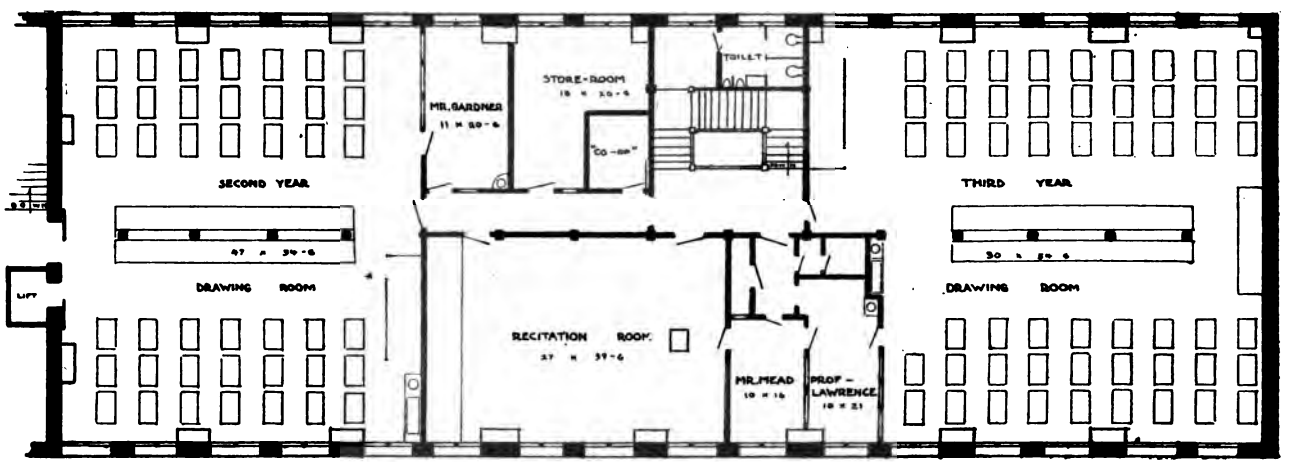
SECOND FLOOR PLAN

PIERCE BUILDING



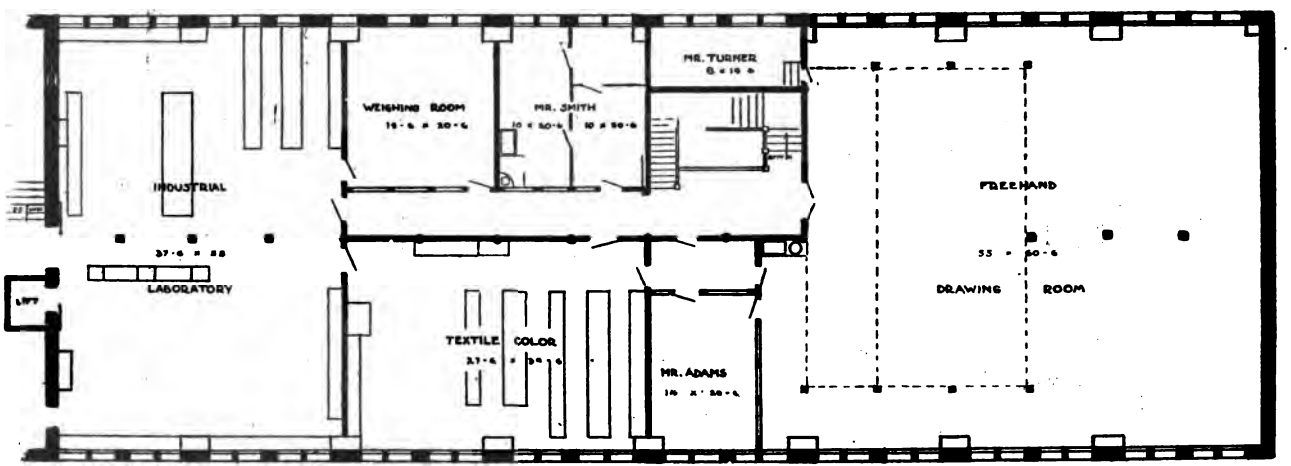
THIRD FLOOR PLAN

PIERCE BUILDING

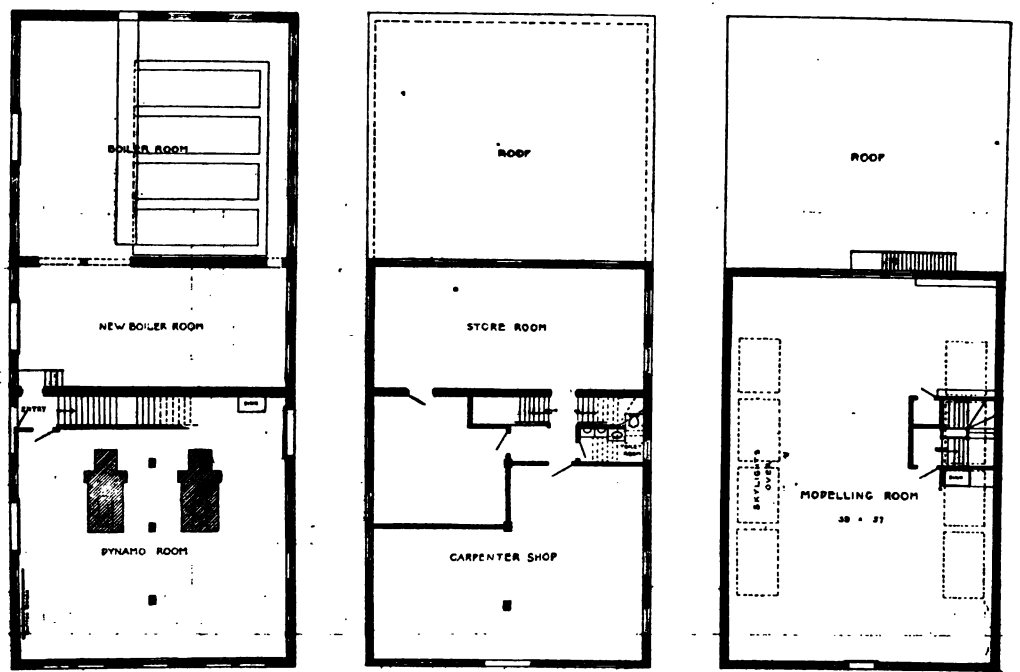


FOURTH FLOOR PLAN.

PIERCE BUILDING



FIFTH FLOOR PLAN



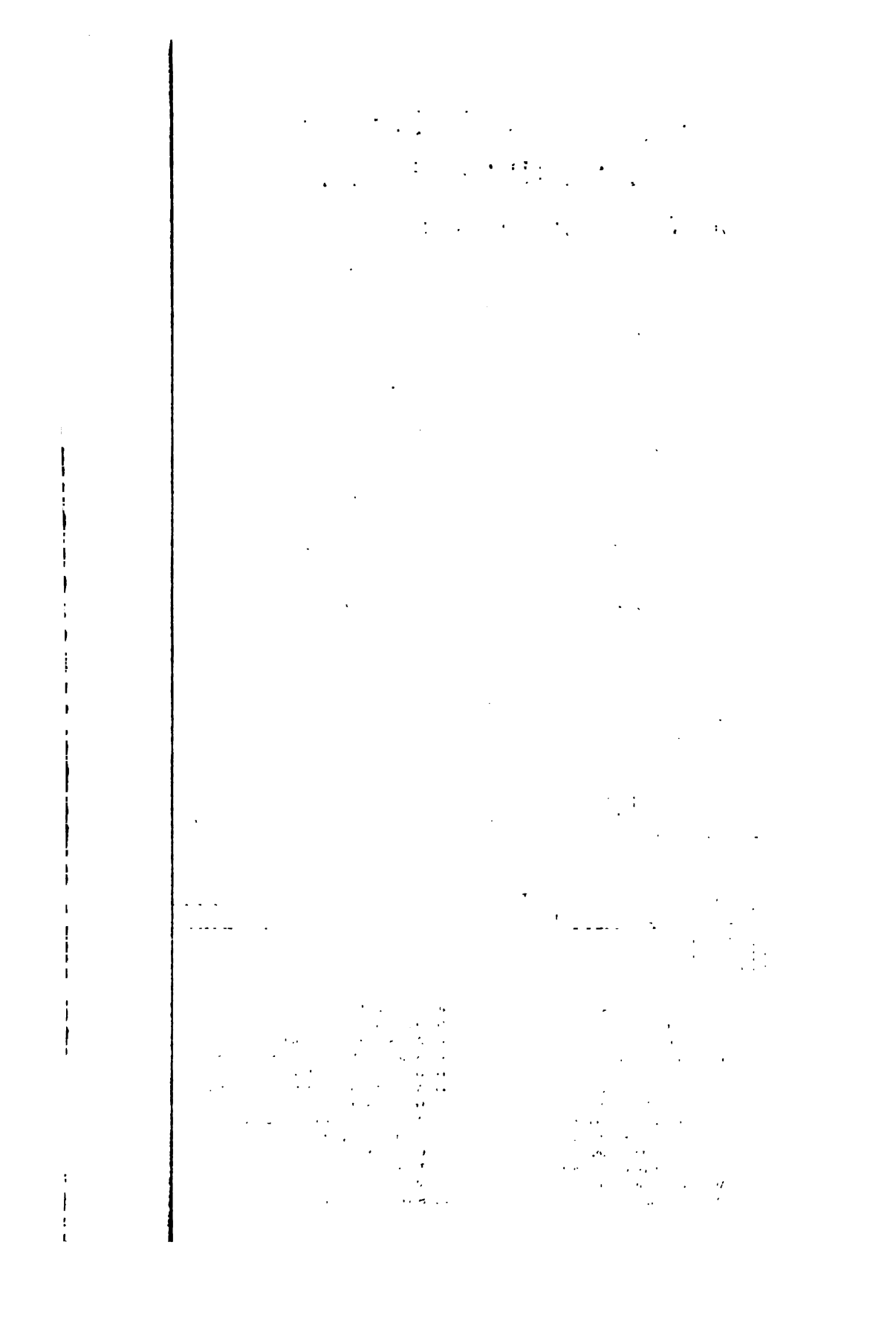
FIRST FLOOR PLAN

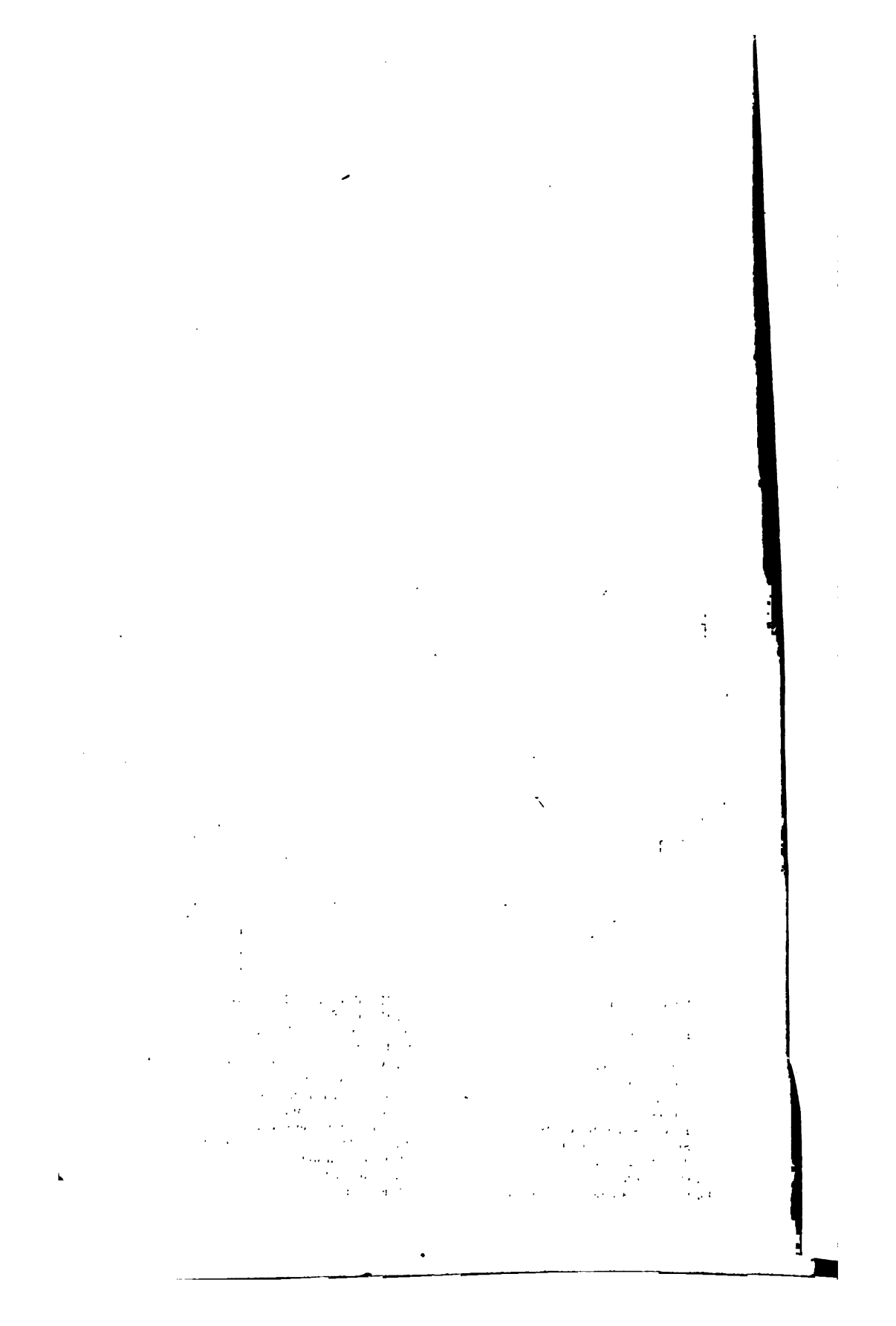
SECOND FLOOR PLAN

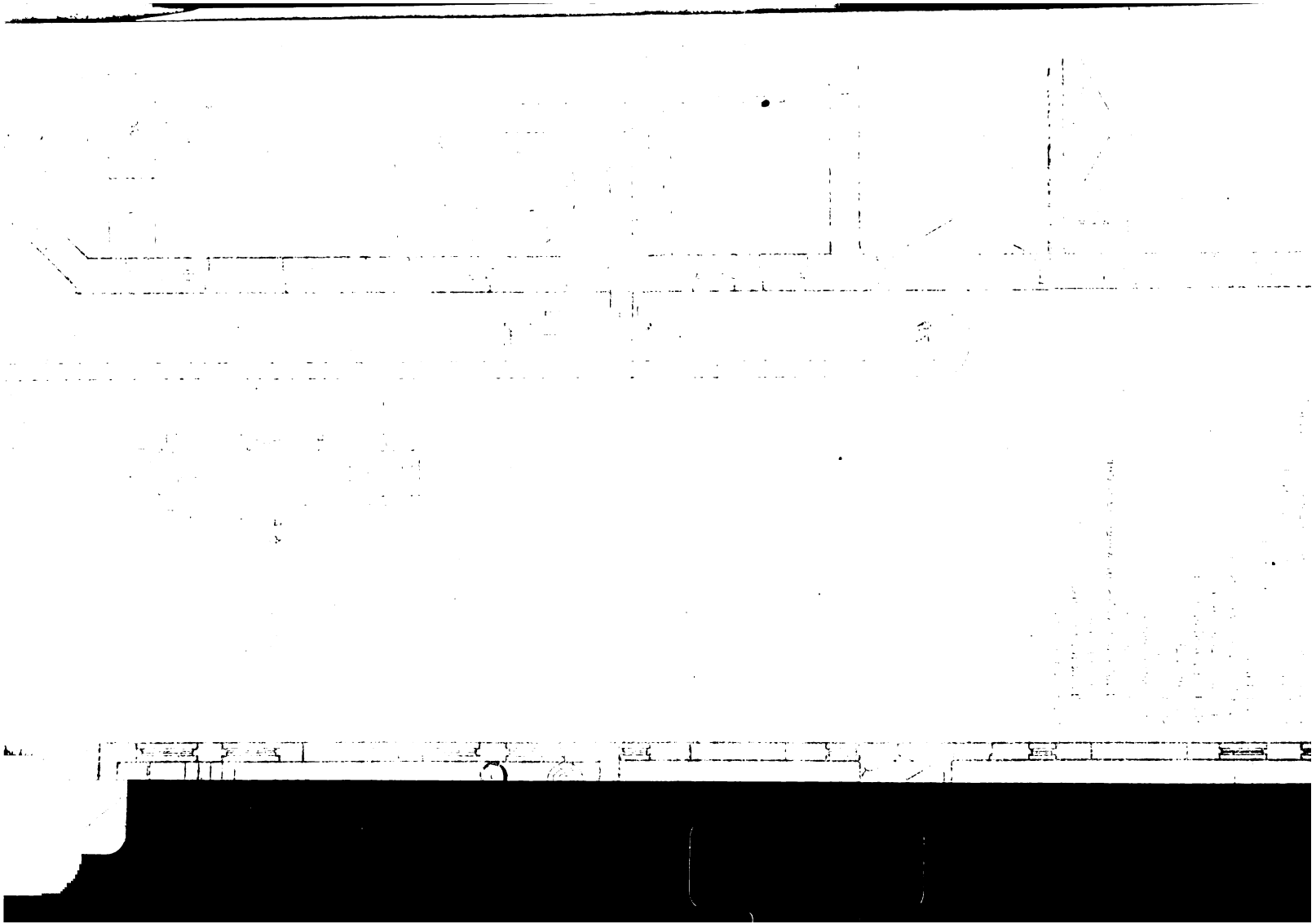
THIRD FLOOR PLAN

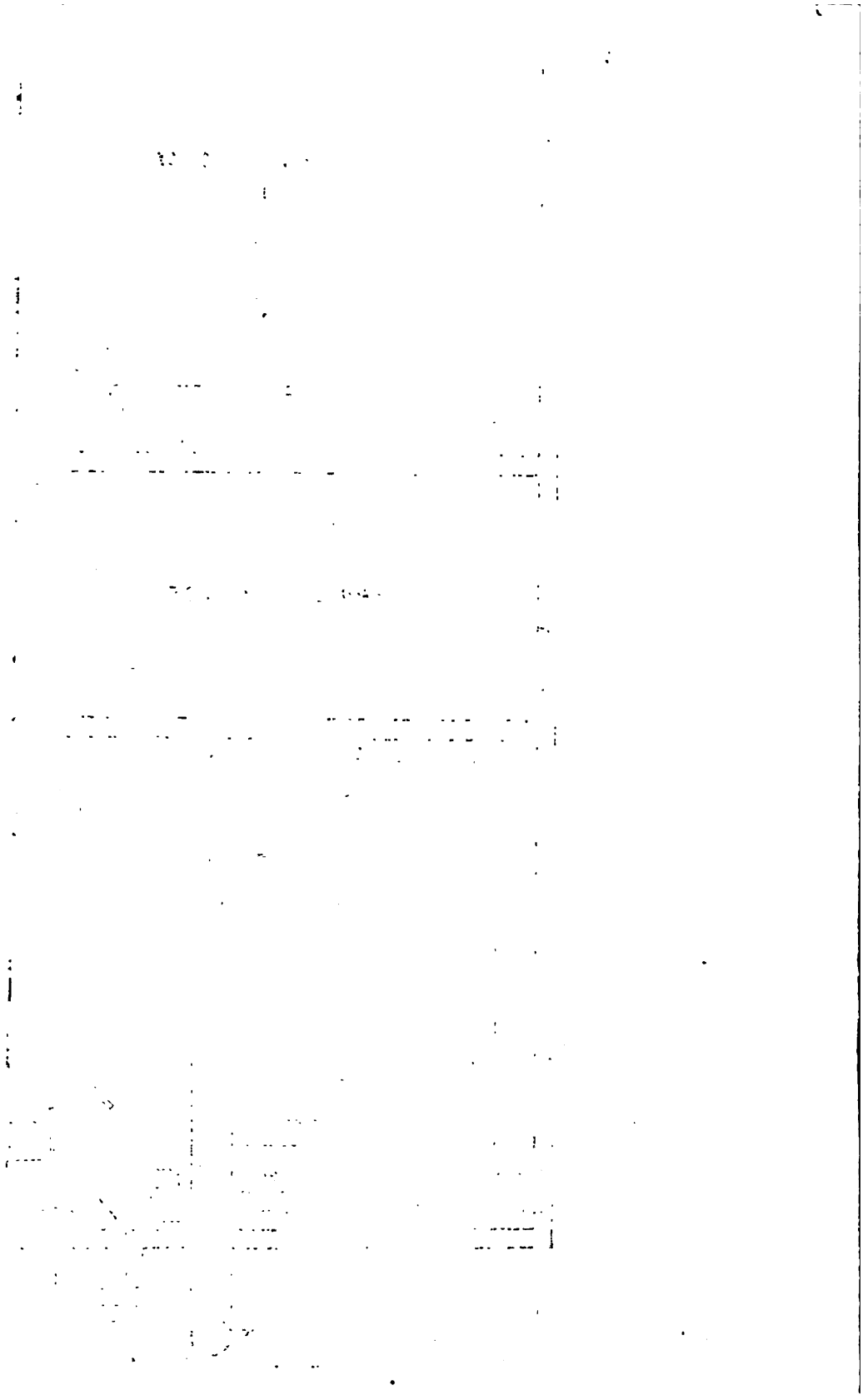
DYNAMO HOUSE - MASS. INSTITUTE OF TECHNOLOGY

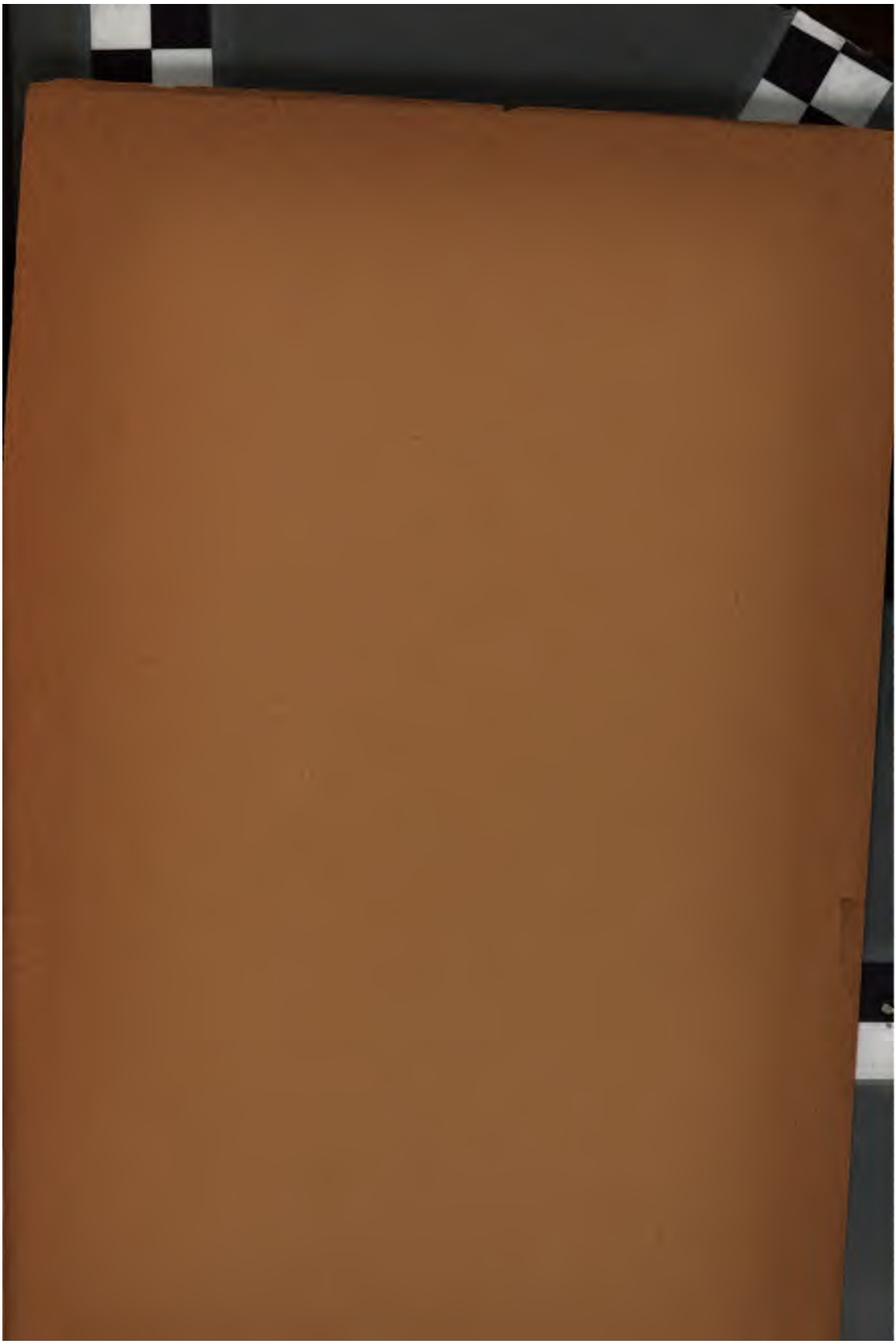
ELEAZER B. HOMER - ARCHITECT -











MASSACHUSETTS INSTITUTE OF TECHNOLOGY

ANNUAL REPORT

OF THE

PRESIDENT AND TREASURER

MASSACHUSETTS INSTITUTE OF TECHNOLOGY.

The President's Report for last year included a list of military records of Institute men who had service in the Spanish War. In view of the impossibility of securing complete information at that time, a separate pamphlet has since been prepared, and will be mailed on application.

January, 1900.

BOSTON:
ROCKWELL AND CHURCHILL PRESS.
1900.

MASSACHUSETTS INSTITUTE OF TECHNOLOGY

ANNUAL REPORT

OF THE

PRESIDENT AND TREASURER,

DECEMBER 13, 1899.

BOSTON:
ROCKWELL AND CHURCHILL PRESS.
1900.

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Communications should be addressed to the Secretary of the Institute.
(See page 16.)

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To the Corporation of the Massachusetts Institute of Technology:

The inauguration of presidents in four neighboring New England colleges has been the occasion for *ex cathedra* utterances regarding the educational problems of the time. The new heads of universities have made solemn declarations of facts and principles, have stated their projects for college government and their conception of the great educational task which they are undertaking, and they have been favored with the advice of their fellow-presidents. The gatherings have been very large, and the whole educational corps has been animated with a sense of the intimate connection between all institutions of learning.

It seems fitting, in taking note of these events, to pass in review our own place in the educational work of the institutions of our country, and to see what share of the advice or comment we can apply to ourselves.

The following points are most worthy of our attention: a college president describes the older days, when the curriculum was intended to contain all the studies necessary for a liberal education, and draws a picture of the good fellowship of the students united in the accomplishment of a simple common task, and he speaks of the development of professional schools as the first of the disturbing elements which complicated the problem of college education. The study of principles and of the methods of inductive science, which the professional schools soon established as their chief work, awakened dissatisfaction with the college curriculum, and the impossibility of teaching everything in four years led to an elective system in colleges. The president of Yale gives a very frank statement of what he calls the dangers and evils of the present system of university instruction, and among them he places loss of *esprit de corps*, and he makes a very

interesting comparison between the academies at West Point or Annapolis and the modern college, giving the following description of the military and naval students: "A homogeneous body of men pursuing a common scheme of studies with a common end in view, and with rigorous requirements as to the work which must be done by each individual. In the modern American college the community of interest is less, the community of hard work is very much less. If this college spirit once passes away, the whole group of qualities known by the name of college democracy is in danger of passing away also."

While desiring to place before you the especial province of the school of applied science, and to make some comparison with that of the college, and using the words quoted as a text to introduce the subject, it would be ungenerous towards the courageous speaker not to point out that the above passage should be interpreted by the whole body of his discourse, and that it formed the prelude to admirable statements of projects for education in manhood and citizenship.

It is a part of our duty as the governing body of this institution to consider how our task and our opportunities may differ from those of other branches of higher education, and I think that we may begin by congratulating ourselves, not upon the superiority of our management, but upon the fact that our task is made a relatively simple one by the character of our students. They come to us with the purpose more or less well defined of taking some share in the achievements of this age of scientific progress; we educate them to this end, and send them out into the world equipped to do certain kinds of work. Whether such an education is not also a general and a liberal one is a question which will be alluded to later. Such a body of students is of necessity homogeneous, for the known fact that this course of study is arduous and demands a mind trained to mathematical discipline operates a selection before entrance, while a prescribed curriculum and a mature understanding of the application of the

studies to professional work lead the students to strive constantly towards a common goal.

Esprit de corps in college is succeeded in after-life by the professional spirit with its declared standard of honor and distinctness of purpose, so that in the civil as well as in the military professions men are bound together, and form a disciplined element in the community.

About ninety per cent. of our graduates are at present following some branch of applied science, and they constitute a considerable fraction of the body of professional men, thirty thousand or more, who are actively occupied with the work for which they were educated, and who are taking a large part in transforming methods of conducting old industries and enriching the country by introducing new ones, as has been done so successfully for chemical manufacturing in Germany. A glance at the present modes of directing work in construction, manufacturing, or engineering shows a strong contrast with the wasteful processes of the earlier part of the century, when the opportunities for a scientific education were rare.

The most important American scientific schools began to be established during the period 1835–1870, and they were the first for the Anglo-Saxon race, since those in England, except mining schools, have followed ours. Before that time some of our engineers were trained in France and Germany, most of them picked up what education they could in an office, and the West Point Military Academy was the only place where a systematic engineering education was given. Among the officers who left the army soon after graduation from West Point somewhat more than half took up some scientific occupation, and the proportion is somewhat larger after long military service, but it is a mistake to suppose that even in those early days a large proportion of our engineers received its admirable training.

The following are the numbers taken from General Cullum's biographical notices: Twelve hundred cadets were graduated at West Point between 1802 and 1843, and of these two hun-

dred and fourteen took up, during some period of their lives before 1867, often a very short time, some occupation related to civil engineering, becoming contractors, surveyors, railroad superintendents, teachers of mathematics, etc. It is plain that civil service was, as it should have been, usually subordinate to military duties, and I cannot refrain from speaking of the testimony borne to the value of the education at our national military academy by these biographies, and of the solemn impression left upon the mind by the perusal of the brief records of early death upon the field or of the long military service of twelve hundred cadets. It can only be compared to a visit to a soldiers' graveyard.

Any institution whose fixed course of studies maintains a high educational standard and strengthens a distinct purpose till it is settled for life is doing its true work as a professional school. The college of to-day seems to be accepting another task as its most important function: that of directing and giving play to scholarly and social tastes, and if we may trust the passage above cited, it is still in search of the most satisfactory methods.

The task of the university which undertakes to direct both systems is a very large one, and it may be well questioned whether it is not too large for a single administration. This opinion usually prevails in Europe, where the professional schools of science have been given an independent existence, and the present year marks an epoch in their development, since the great Polytechnic School of Charlottenburg has acquired the right to give the degree of Doctor of Philosophy. This step was taken by special intervention of the German Emperor after active opposition from the University of Berlin. The next step seems likely to be the attempt to establish a diploma for applied science, to which the university degree shall be preparatory.

In this part of our country, where the resources of the state are sparingly employed for higher education, the choice has not been free, and it has usually been a matter of necessity to utilize small funds to the best advantage by adding scien-

tific branches to college studies, and most of our scientific schools have so grown up under the shelter of a college. They have often been organized by men outside of the college, and in some instances their early history has not been a story of tender nurture by their alma mater, although at present our universities are proud of the growth of their schools of applied science and consider them an integral part of their system. Some of these schools have gained during their youthful experience a habit of taking care of themselves which has been decidedly to their advantage, since their faculties and trustees have acquired and maintained a considerable share of independence of action.

Our northwestern states have undertaken university education at public cost and on a liberal scale, and the universities have grown with great rapidity. All branches of higher education have been united under a single management, and the size, the strength, and the completeness of its university are matters of pride to the state. The unity of administration is promoted, at least in theory, by putting its control in the hands of a small board of regents appointed by the Governor or elected by the people. These are men of prominence whose influence is potent in presenting budgetary and other interests to legislatures. The president and faculty usually take the initiative in the appointment of professors and instructors. We find in the state universities departments of law, medicine, engineering, and more rarely of architecture, and frequently our own courses have served as models for teaching applied science. Some of the universities founded since 1865 by private endowment have also given from the beginning equal place to the applied sciences and to the academic departments.

Such have been the circumstances amid which our important scientific schools have been developed, and generally attached to a university. The pioneer among them, however, the Rensselaer Polytechnic Institute at Troy, has had no such support, and our own school with its larger programme has been fortunate in finding at Boston a centre of educational enterprise ready to aid and sustain an institution striving to

find new means of satisfying new demands. The founder of this school and his successors have laid these problems before you, the governing body. You have aided in the solution, and have helped to bring new questions before the whole community, and we are now enjoying the fruits of our independent existence and of the undivided attention of our Faculty and Government to an educational scheme more simple than that of our universities, while the reputation of the school is built upon the unhindered devotion of Faculty and students to a distinct and high professional ideal in education.

Some allusions have been made to the differences between foreign institutions and those of the United States, and it is worth while to say a few words regarding an American institution which scarcely exists elsewhere, namely, the trustees or lay government of educational establishments in this country. It is often supposed that all the oldest universities of Europe were in the hands of the clerks, as was the case at Paris and Oxford; but the earliest of all, in Italy, were schools of law and medicine, and were more democratic than any which have been known since. They were governed by students who hired their professors, told them what to teach, and decreed fines, and even the death penalty for neglect of duty. To-day in Europe the selection of teachers and the introduction of new studies are the province of the ministry of public instruction, and such questions are consequently dealt with by a permanent board of experts. In America groups of citizens have taken upon themselves to decide the most intricate educational questions; boards of trustees have received charters from the states conferring upon them various degrees of authority for the government of our universities. Usually they have complete control of financial affairs, but often the President and Faculty have considerable power in the appointment of teachers. These lay bodies confer degrees after examinations by the Faculty, and occasionally they have abused their privilege to confer the honorary degrees of M.D. and Ph.D. without examination.

The founders of colleges have been moved sometimes by

recollections of their scholarly days, but more often by the generous desire to provide for others privileges which were lacking in the arduous time of their youth. Men in the hurry of a business life have been mindful of the tastes and wants of the abstruse scholar; and schools of applied science have been founded and sustained by directors of our great enterprises who had little schooling themselves, or whose college course was restricted to classical studies. These citizens have well understood the needs of their time and country; in some cases they have formulated[1] them with signal distinctness and good judgment, and have called upon men of learning to carry out their plans. This conjunction of circumstances has been most favorable when innovators in education, like Rogers and Walker, have met men like John Cummings and others who have participated in the government of this school, and carried on an enterprise with faith and constancy through many evil days. Such governing bodies, unlike ministries of education abroad, have frequently been obliged not only to decide upon new courses of study, but also to pay for them from their own pockets, and each demand has met with a generous response not only from those of our own government and from our alumni, but also in a very remarkable way from men quite unconnected with the Institute who have put their wealth in your hands for distribution without reserve or restriction. It is easy to understand that the expenditure of funds under these conditions should be made with the shrewdness of the best business methods, and economy of production is one of the most notable features of American institutions of higher education, and is sometimes in strong contrast with those of Europe. Former reports have alluded to the attention which American methods of education in science have attracted in Europe, and again this year we have received visits and requests for information from persons charged with the establishment of schools of applied science in England, in Germany, and in Russia.

The citations in the beginning of this report have been

[1] See letter of Abbott Lawrence reprinted in "Engineering News," 1892, 460.

used to call attention to the contrasts which exist between the training of the scientific school and that of the college. During the thirty-four years which have elapsed since the foundation of this school two systems of education have progressed along divergent roads, and, curiously enough, it is now only a portion of the colleges and the schools of applied science which have been faithful to certain scholastic traditions which have been wholly or in part abandoned by many of the colleges. Professional requirements have compelled us to establish complete courses of graded and interdependent studies leading to a degree of bachelor of science, and, although we cannot say, as was said of the old degree of bachelor of arts, that it testifies to the attainment of all liberal knowledge, we can affirm that a student who has ascended step by step through such a course has received mental training which sends him far on the road to a liberal education, and that he has received the best guidance in the art of using one piece of knowledge to learn another.

The school of applied science is with reference to general studies intermediate in position between the college and those law and medical schools which require collegiate preparation for entrance. These professional schools can assume that their students have had the requisite general culture, and confine their teaching exclusively to professional subjects.

Our students are of collegiate age, usually with high-school preparation, and for them a strictly professional course would be too narrow. Our single degree of Bachelor of Science is intended to mean that a student has not only been taught facts and methods, but also that some attention has been given to the literary presentation of ideas, and that he has such an acquaintance with the range of modern thought as will show him where to look farther for general culture. No attempt can be made to enable him to explore in the original language those noble documents which have preserved the genius and learning of the past, and the great branches of ancient languages and literature so important in university studies find no place in our curriculum. Philos-

ophy is also omitted. The remaining groups under which university studies may be classed are taught to our students; namely, Modern Languages and Literature, including English; Mathematics; Chemistry; Physics; History and Political Science; Natural History; Architecture, and History of Art. The two latter subjects are treated as professional, and do not enter into all the courses. French and German are taught at the beginning of the course, so that the student can within the limits of technical studies make use of the languages as a Frenchman or a German does to acquire knowledge of facts; and such knowledge is required for use in many of the courses. The habit so acquired of freely using foreign languages opens the door to the enjoyment of modern literature. We have carefully guarded the time set apart for general studies like History, Literature, and Political Economy against the encroachments of professional subjects; but it is all too short to accomplish its object.

It must be frankly admitted that the old ideas about the relative dignity and precedence of studies have everywhere been abandoned, but questions of utility concerning the different branches of general studies are still under consideration, and these are more easily settled in a scientific school than in a college, because the declared purpose of the student is more definite. It is not, however, to these matters that reference was made in speaking of old traditions, but rather to the prescription of curricula made under the assumption that a teacher, or rather a council of teachers, can offer the best plans for a symmetrical course of study. The heads of some of our universities, after long trial of the elective system, hold exactly the opposite opinion regarding the needs and desires of their collegiate students, and the results of complete freedom of choice are spoken of with unqualified approval. Moreover, it is a significant fact that no active discussion of these diverging points of view is now going on in educational journals, and earnest convictions favored by reasons of convenience and popularity are spreading the elective system through our colleges. It is not within our province to criti-

cise this policy as applied to colleges, except in so far as we are called upon to defend our own system against the opinion that we are giving the narrower, and the college the broader education. The classical studies are not within the compass of a four years' course for a degree of Bachelor of Science, but the degree of Bachelor of Arts is equally narrow, for it may be taken with few scientific studies, and, in fact, mathematics, the experimental studies, and particularly physics, are neglected in colleges where the choice is free, in a way to show that in this age of scientific achievements intellectual curiosity does not run parallel with the progress of the times. Science was more popular with literary men during the last century, when every one desired to be encyclopædic, and a picture of the times is given by Voltaire's stay with the Marquise Du Châtelet at Cirey, where the lady was publishing the philosophy of Leibnitz, and her friend paid his court by editing Newton's Principia.

Athletic sports are ever growing in importance and do much to establish the popularity of our institutions of learning. A football game was this year offered as part of the inaugural exercises of a western college, and advertisements of preparatory schools show woodcuts of the pupils on horseback, in boats, or on the football field. Such sports can never receive the same attention in this Institute that they have at present in the more leisurely college life, but it may be explained that it is not the severity of our studies, but rather the time consumed in laboratory work and in drawing which makes the successful pursuit of competitive athletics difficult. Exercises which should be enjoined on a sedentary student, were it necessary to lay injunctions, are less important for ours, who are kept on their feet a considerable portion of the school hours, but every one knows that gymnasium work is restful as well as pleasant after other active occupations, and time and opportunities are offered for such exercises even with our present gymnasium, which is looked upon as a temporary one. Reference will be made later to a project for the erection of

a new building which will doubtless give great impetus to interest in physical exercises.

The popularity of college life which is taking young men from their homes to live in college towns depends greatly upon its social side, and in small towns where the population is collegiate the direction of the social element — taking the word in its broadest sense — presents great importance and considerable difficulty. Perhaps the best results for Anglo-Saxon youth have been obtained in England, where those unique associations of teachers and students which form the colleges within the university, although founded originally as charities for poor scholars, have now established a most agreeable and instructive, though somewhat expensive, mode of living for the wealthy. These units of the university organization offer some of the safeguards and pleasant features of family life, and they serve to promote friendly rivalry in athletic sports within the university. In America athletic events are rarer. They take large proportions between universities, and suffer from publicity and from the intervention of the newspaper, often a disturbing element in modern education. Students dwelling together have established clubs here and elsewhere, which have nothing classic about them except their Greek-letter names, and which do not fulfil the offices of colleges. But when not too elaborate they form pleasant associations of young men with tastes and occupations in common, and they are small centres in which good fellowship and attachment to their institution have active sway. Our own position is far removed from that of a collegiate town, because students coming from abroad soon come in contact with the larger society of a city, and this is facilitated by the fact that nearly half of our students live in their own homes and doubtless introduce their comrades to them. It may be added that this fact does much to lessen the temptations incident upon residence in a large city.

A change is now taking place in our northwestern states which will tend, if it spreads, to shorten the time of residence in colleges and in institutions like ours. The citizens of

those states demand and obtain in many of the large towns a gratuitous advanced course in their high schools intended to be nearly equivalent to the freshman and sophomore years of colleges. The students can thus remain in their homes to complete a course which they regard as final, or go to college only for the last two years. It does not yet appear that this change has had any effect upon the time of entrance of our northwestern scholars, and it is probably more than counterbalanced by measures taken to keep them at home. The University of Michigan makes a reduction of fees for citizens of the state, and the rates are so low in all the state universities that students are less disposed to go abroad. [California offers free tuition, with alluring advertisements of cheap board, and the tuition at other state universities is from $15 to $30.]

It is impossible for our endowed institutions to compete in the price of tuition with those supported by public funds, nor does our policy at present tend in that direction. We are endeavoring to use the funds placed at our disposal, not to make education cheaper, but to make it more valuable. Each yearly report gives an account of new men and apparatus added to our means of education, and last year it was stated that the cost of educating a student greatly exceeded his tuition fee, so that, if he looks upon his professional training as an investment which should bring in a quick return in the form of a professional salary, the investment may be considered each year a better one. It is fully appreciated that our high tuition fee would place our school beyond the reach of worthy scholars, were it not that generous donors have within the last two years added largely to the scholarship fund, so that now an income of about $24,000 can be applied to providing free, or partially free, tuition, while important sums in addition to that above named can be used to aid the graduate work of advanced students and teachers.

Although special foundations for professorships have been a common form of donation, sometimes an embarrassing one when the fund has become inadequate, it is very rare that funds have been made available for the benefit of

members of the instructing staff prevented from performing active duties as teachers. Mr. Augustus Lowell, who has long studied the needs of our Institute, having been a member of the Executive Committee since its establishment sixteen years ago, has this year taken the initiative in the establishment of a fund which is intended to provide for this want. His letter, accompanying a gift of fifty thousand dollars, expresses the wish that this sum shall be the nucleus of a fund of which the income shall be used for the benefit of the teaching staff of the Institute in cases of illness, death, or retirement, subject to such regulations as the government may from time to time see fit to adopt. The donor has left the door open for others to associate themselves with him in this good cause by requesting that the fund shall have no personal designation, and it is earnestly hoped that the foundation proceeding from this generous nucleus will grow to be commensurate with that for scholarships.

It will be noticed that Mr. Lowell's gift is not called a pension fund, and that the only restrictions made upon its use serve to indicate a general purpose without hampering the freedom of action of our government. Our charter and our customs have given the Corporation, acting through its Executive Committee, larger powers than those possessed by most college trustees, and there is every reason to think that the Faculty will feel that their interests will be better cared for if no binding regulations are made at the present time. It does not seem necessary for us to make any rule until the fund has become larger, many cases have been dealt with, and customs established.

Steps have been already taken in other institutions to make the pension system part of the contract between government and teacher, in order to give greater security to the latter, and the idea is good; but the execution stumbles upon difficulties, chief among which may be named the impossibility of distinguishing by rule between qualities of work, and the difficulty of fixing for either side the time for terminating a service. The military system cannot be

applied in the same way to all colleges, because they differ greatly in the mode of appointment and continuance in office of their professors. Usually the question of the obligatory retirement at a certain age would be raised, and for us this would be a new issue which we are not called upon to deal with at present, and we may continue to hope that the Faculty will lose no professor until the professor has lost his faculties.

The Corporation has this year lost two of its members by death. Walbridge A. Field, Chief-Justice of the Commonwealth, was an *ex officio* member. Judge Field's high abilities and character would have been looked to for support in time of emergency; but, although he was acquainted with our work and took a friendly interest in it, his official duties prevented him from taking part in our deliberations.

Mr. Samuel Johnson was elected in 1897 a member of the Corporation and served on the Committee on Finance. His death deprives us of the counsels of a man whose fidelity and good judgment had caused his advice to be sought by many important enterprises of private and charitable business.

The Faculty has lost by death the head of the Department of Modern Languages, Prof. Alphonse N. van Daell, who was granted leave of absence to seek a health resort in Europe, and died at Wiesbaden after a very short illness, March 27, 1899. Dr. van Daell was a member of a distinguished Belgian family, and after accomplishing an extended course of study in the universities of Louvain, Liège, Paris, Bonn, and Berlin, he came to America in 1876, and held professional positions in our schools and colleges until, in 1886, he became director of the course in modern languages at the Boston High and Latin Schools. In 1889 he accepted the chair of modern languages in the Institute.

He made himself not only the master of our language, but also of our modes of thought, and took a keen interest in the affairs of his adopted country, so that he possessed rare qualifications for successfully imparting a knowledge of foreign languages and literature. Added to the accurate and wide

learning of a scholar was the intimate association with European life of an accomplished gentleman. His kindly interest in the students and his zeal and conscientious care made him an excellent teacher, while his genial qualities made his companionship agreeable and instructive to all who knew him, and his loss is deeply felt by his colleagues.

Walker Memorial Gymnasium.

A committee of nine members has been appointed by the Alumni Association to take steps to procure funds for raising a suitable memorial building for a gymnasium, and an encouraging interest in the undertaking has been shown by former students of the school, now numbering about six thousand. One of our principal buildings already bears General Walker's name, and the desire has been universal to perpetuate also in this new building the remembrance of his active and manly interest in the physical as well as the moral welfare of our students. It is hoped that the subscriptions will reach one hundred thousand dollars; and the plan of the committee will very probably include some accommodations for student reunions, and perhaps other social purposes.

The Buildings.

Considerable expense has been incurred this year in permanent improvements upon the Rogers and Walker buildings. Three fire-escapes of substantial design, in keeping with the outlines of the buildings, have been put up, and some changes of rooms are noted in the reports of departments.

A bronze tablet commemorative of the military service of General Walker was presented by the Commandery of Massachusetts of the Loyal Legion, and has been placed near the entrance door of the general library.

The principals and teachers of neighboring schools were invited to visit the Henry L. Pierce Building on the 14th of February, and the visitors were shown the rooms devoted to

architecture, biology, geology, and industrial chemistry, in each of which are new and interesting accommodations for science teaching.

Telephones. The Bell Telephone Company has again shown its consideration for our work in pure science as an ally to industry, and we owe to its liberality an important telephone service between our different buildings. The somewhat complicated system, with twenty-seven stations, was planned by Mr. Hammond V. Hayes, electrical engineer of the company, and by Professor Puffer, and we owe thanks for their good offices as well as for the very generous favor extended to us by the Company.

Paris Exposition.

The Institute has been invited by the United States Commission to take part in the educational exhibit at Paris in 1900. Cornell University and the Institute are asked to represent engineering and architecture.

The Commission has made a special allotment of wall space in response to our request for place to display architectural drawings, and although it is not as large as desired, it is hoped that a proper exhibit can be made. Photographs with explanatory text have been prepared to show the scope and methods of instruction at the Institute, and special attention has been paid to architecture and the engineering departments in order to meet the wishes of the United States Commission.

The Library.

This is the tenth report since the establishment of the office of Librarian, and it may not be inappropriate to preface it with a brief review of the growth of the Library during these ten years. Dr. Bigelow reports that until the year 1889 such books and periodicals as were needed were purchased by the professors as part of the laboratory supplies of their respective departments. There was no uniformity as to the arrangement or cataloguing of the books, and nothing was done to prevent duplication. The receipt by the Chemical

Department of the library of Professor Nichols led to an arrangement being made whereby Mr. C. W. Andrews, Instructor in Chemistry, was engaged to spend his summer vacation in cataloguing the library of that department. Later he accepted on similar terms the task of making a general catalogue of all the books in the Institute — an undertaking which undoubtedly seemed the more necessary because of the recent receipt of a large and very valuable collection of books and pamphlets from Mrs. W. B. Rogers. Finally, in 1889 Mr. Andrews was appointed Librarian of the Institute. After a careful examination of the different systems in use, the Dewey system of decimal classification was adopted and applied to all the books. In order to prevent unnecessary duplication a rule was adopted that all new books should be purchased through the librarian; but several copies of the same book may be required for use in different departments.

When Mr. Andrews entered upon his new position the Institute possessed about 17,545 volumes and perhaps 8,000 pamphlets, distributed in ten libraries, of which only five had been catalogued. From this time on, the new books were catalogued when received, and by devoting his summers to the work Mr. Andrews succeeded in completing the catalogue of old books in 1893. The amount of work and the disadvantages under which it was done can be fully appreciated only by one who has attempted a similar task. The room provided for an office was very small and inadequate, and the duties of the librarian included everything from the work of office boy upward, except a certain amount of routine clerical work that was intrusted to an assistant. The only aid received from attendants in the departmental libraries was in copying the cards for the departmental catalogue, mostly done by hand. The General Library was then simply a place where first-year students might study their lessons, and where books could be stored that were not wanted elsewhere. The other libraries, although small, contained many books and sets of periodicals of great value.

At the end of the fiscal year 1898–99 the total number of

volumes in the libraries of the Institute exceeds 50,000 and the total value of the libraries is estimated at $112,000. The librarian has an office which, although small, is sufficiently commodious for the ordinary work. He has an efficient assistant, who is a trained cataloguer and is capable of undertaking any part of the work that may properly be delegated to an assistant. Three of the attendants in the departmental libraries are also skilled in cataloguing, and do that part of the work for their respective departments under the supervision of the librarian. All cards added to the general or the departmental catalogues are typewritten. The libraries of the departments of English, Modern Languages, and Military Science having been incorporated with the General Library, and the whole housed in a suitable room, the General Library is much more nearly what its name implies, although much is still to be desired in that direction.

An examination of the following table will show that the growth of the libraries in number of volumes has been steady and continuous. The average annual increase for the ten years is 3,260 volumes. The minimum is 1,867, and the maximum 4,080, occurring in the first and second years respectively.

GROWTH OF THE LIBRARIES DURING THE TEN YEARS FROM 1889 TO 1899.

YEAR.	1889.	1890.	1891.	1892.	1893.	1894.	1895.	1896.	1897.	1898.	1899.
Net accessions, vols.	. . .	1867	4080	3320	3607	4045	3190	3387	2974	2696	3438
Total vols., Sept. 30	17545	19412	23492	26812	30419	34464	37654	41041	44015	46711	50149

The separate contribution of each department toward the total growth is shown by the table which follows:

GROWTH OF THE LIBRARIES BY DEPARTMENTS DURING THE TEN YEARS ENDING SEPT. 30, 1899.

LIBRARIES.	ANNUAL INCREASE IN VOLUMES.		
	Average.	Maximum.	Minimum.
History and Economics	653.5	963	448
Engineering	641.9	900	233
General[1]	421.8	720	115
Physics	396.0	587	99
Chemistry	380.0	476	272
English	203.7	479	89
Architecture	158.7	265	61
Mining	156.4	271	106
Biology	133.5	194	56
Geology	101.0	212	22
Margaret Cheney Room	13.9	36	0
Total	3,260.4		

Owing to differences in the rate of growth the relative sizes of the libraries have changed considerably during the ten years. In 1889 the largest library was the Chemical, with 3,756 volumes, and the one next in size was the Library of History and Economics, having 2,969 volumes. Now the Library of History and Economics is the largest, having 9,504 volumes, and the Chemical Library with its 7,556 volumes is reduced to fourth place, while the Engineering Library is next to the largest, having reached the considerable size of 8,822 volumes. These departmental libraries still maintain their place, however, among the leading technical libraries of the world.

Our system of departmental libraries is a product of the natural growth of the Institute, having arisen by the accu-

[1] Until 1897 the libraries of Mathematics, Military Science, and Modern Languages were regarded as a part of the General Library, as in this table, while the English Library was regarded as separate.

mulation of books purchased from time to time as they were needed for the use of the various departments. When it began to be realized that in these scattered collections we possessed a library of considerable size and of great value, the departmental system had become so firmly established and was found to meet the needs of the Institute so well that there was little thought of making any change.

This system was adopted from the start by Johns Hopkins University and the University of Chicago, and within the last few years the principle has been applied cautiously and to a limited extent in some of the other leading universities which formerly had simply one central library. Thus at Harvard, while the great departments of the university like the Law School, Divinity School, and Zoölogical Museum have long maintained separate libraries, it is only recently that sixteen "Laboratory and Class Room Libraries," aggregating 20,500 volumes, have been established for the various departments of Harvard College. The only trace of this system at Yale appears to be in the library of the Sheffield Scientific School, consisting of about 5,000 volumes, largely mathematical. From this there is set apart a special Chemical Library, a small library of History and Political Science, and private technical libraries on the subjects of Geology and Mineralogy. In his report for 1897 the librarian of Columbia University states that departmental libraries are about to be established for the departments of Zoölogy, Mineralogy, Geology, Palæontology, and Mining. At Cornell University about 15,000 volumes out of a total of 196,000 in the general library are deposited in the seminary rooms and department and laboratory collections.

The libraries of five of the great technical schools of Europe, as classed in Minerva,[1] surpassed ours in the number of books in 1897–8: Hannover, 145,000 volumes; Vienna, 81,044; St. Petersburg, 75,500; Buda Pesth, 55,682; Aix-la-Chapelle, 48,000.

[1] No statistics in regard to libraries are given for Charlottenburg nor the schools of London and Paris.

During the year 1898–9 the following additions were made to the library:

By purchase	1,621
From the bindery	878
Gifts	1,616
Total accessions	4,115

After deducting books purchased to replace lost volumes, books counted twice, etc., the net accessions are 3,438 volumes, 527 pamphlets, and 24 maps. The distribution of these accessions and their cost among the different departments is exhibited in the table below:

TABLE OF NET INCREASE DURING THE YEAR 1898–99, SHOWING THE COST OF THE SAME, AND TOTAL CONTENTS AND ESTIMATED VALUE OF THE LIBRARIES OF THE INSTITUTE, SEPT. 30, 1899.

LIBRARIES.	NET INCREASE.				TOTAL CONTENTS.		
	Volumes.	Pamphlets.	Maps.	Cost.	Volumes.	Pamphlets & Maps.	Estimated Value.
General Library. (General	249	143	.....	$80.11	4,254	3,566	
General Library. (English	163	1	.....	181.77	2,535	38	
General Library. (Mod. Lang.	48	.....	.....	110.32	642	18	
General Library. (Military Sci.	6	.....	.....	5.35	142	6	
Totals Gen. Lib.	466	144	.....	$377.55	7,573	3,628	$10,570
Architecture	223	10	.....	794.82	2,448	210	18,402
Biology	114	15	.....	165.64	2,185	419	4,890
Chemistry	328	31	.....	557.36	7,556	1,546	16,932
Engineering	900	184	23	1,488.59	8,822	3,581	20,123
Geology	93	4	.....	107.14	1,931	822	4,412
History & Economics,	496	44	1	525.06	9,504	3,165	14,988
Mathematics	258	11	.....	652.06	906	174	2,028
Mining	271	66	.....	274.92	2,325	407	5,196
Physics	272	18	.....	421.42	6,283	707	13,964
M. Cheney Room	17	.....	.....	.....	616	13	1,357
Totals	3,438	527	24	$5,364.56	50,149	14,672	$112,866

The value of the libraries was calculated as follows: Architectural Library at $7.50 per volume, Library of History and Economics at $1.50, General Library at $1.30, all other libraries at a general average of $2.20, and all pamphlets at 20 cents. These figures were adopted after a careful study of the cost of total accessions by purchase and binding from Oct. 1, 1890, to Sept. 30, 1898.

We are now receiving 840 periodicals and other serial publications at a total cost to the Institute of about $2,000 per annum, as is set forth in detail in the following table:

TABLE OF PERIODICALS AND OTHER SERIAL PUBLICATIONS RECEIVED DURING THE YEAR 1898–99.

LIBRARIES.	NUMBER RECEIVED.					ESTIMATED COST.			
	Gifts.	Paid by Dept.	PERIODICAL ACCOUNT.		Totals.	Paid by Dept.	PERIODICAL ACCOUNT.		Totals.
			Exch.	Subs.			Exch.	Subs.	
General . .	32	1	16	26	75	$6.00	$38.40	$84.47	$128.87
Architecture,	2	2	7	30	41	4.40	16.80	178.41	199.61
Biology . .	15	6	8	37	66	21.10	19.20	230.94	271.24
Geology . .	16	1	8	5	30	2.50	19.20	20.95	42.65
Chemistry .	86	14	13	39	152	42.95	31.20	185.53	259.68
Engineering,	48	24	56	54	182	51.12	134.40	233.41	418.93
History and Economics,	50	28	5	68	151	61.19	12.00	225.79	298.98
Mathematics,	. .	. .	2	13	15	. . .	4.80	52.93	57.73
Mining . .	10	3	21	22	56	4.95	50.40	77.87	133.22
Physics . .	9	13	28	29	69	9.49	67.20	146.44	223.13
Lowell School of Design.	. .	. .	. . . .	3	3	. . . . .	. . . . .	10.00	10.00
							$393.60	$1,446.74 393.60	
Totals . .	268	82	164	326	840	$203.70	. . . . .	$1,840.34	$2,044.04

The remaining statistics of the libraries for the year may be tabulated as follows:

SUMMARY OF EXPENDITURES FOR THE LIBRARIES, EXCLUSIVE OF SALARIES.

Books and binding	$5,364.56
Periodical account	1,933.02
Expense account	233.79
	$7,531.37
Less receipts from sale of duplicates	90.16
Total	$7,441.21

OTHER STATISTICS OF THE LIBRARIES.

Number of orders issued for purchase of books	1,376
Number of order slips returned to heads of departments as duplicates,	191
Number of the same reordered	14
Suggestions for purchase sent to heads of departments	1,743
Number of the same approved	462
Books received for inspection	281
Number of the same purchased	63
Number of orders for binding and lettering	1,278
Cards added to the general catalogue	2,811
Total number of cards in general catalogue	44,953
Books and periodicals borrowed for home use:	
General Library	877
Biological Library	215
Chemical Library	1,938
Engineering Library	2,270

The statistics in regard to the borrowing of books represent only a part of the use made of the libraries. Not only have a large number of books been borrowed from the libraries not mentioned in the list above, but in all the libraries many books are being used constantly for reference without being taken from the room, and no record is kept of the books used in this way.

During the year considerable progress has been made upon a subject catalogue of the Chemical Library, although the only time available for this purpose has been what the assistant in charge could spare from her other work. A beginning has been made on subject catalogue of the books on public health and sanitary engineering in the Engineering Library by the assistant in charge of that library. The plan is to make ultimately a complete subject catalogue of all the books on that subject in the Institute, this being especially desirable

because the books are divided between the Engineering, Chemical, Biological, and Architectural Libraries. The subject entries are made upon colored cards to distinguish them readily from the author and title entries, and they are filed alphabetically in the general catalogue with the other cards. When the plan has been carried out, it will be possible for any one wishing to look up the literature to come to the general catalogue and there in one alphabet find under the subject headings references to all books on these subjects in any of the libraries of the Institute. Copies of the subject cards will also be filed in the catalogues of the libraries in which the books are placed. These beginnings are but part of a plan to make the general catalogue finally a complete dictionary catalogue, both by author and subject, of all the books in the libraries of the Institute. As an author catalogue it is complete, but the completion of the subject part is an ideal which it will take many years to attain with the force at present at the disposal of the Librarian.

Of the gifts received during the year special mention should be made of the following: — a number of reports and public documents from Senator George F. Hoar and Hon. Samuel W. McCall; 194 volumes, chiefly on engineering and mining, belonging to the late Gorham P. Faucon and presented to the Institute by his mother; from Mrs. Sarah A. Floyd, 11 volumes on chemistry, from the library of her son, Charles W. Floyd; from Professor Richards, Rziha, Lehrbuch der gesammten Tunnel-Baukunst, 2 vols.; from the authors, Report on the Purification of the Ohio River Water at Louisville, Kentucky, by George W. Fuller, and Matter, Energy, Force, and Work, by Prof. S. W. Holman; from Professor Burton, Flammarion, Popular Astronomy, Whymper, Travels among the Great Andes, Muster-Blätter f. d. topographischen Arbeiten d. k. preuss. Landes-Aufnahme, Compte rendu de la Congrès internationale des Sciences géographiques, 1891; from Mr. Samuel Cabot, Vignola, Règles de cinq Ordres d'Architecture. Mrs. Henry Draper has sent us the third volume of Sachs, Modern Opera Houses, and she has continued her subscrip-

tion to Comptes rendus de l'Academie des Sciences de Paris. Mrs. W. B. Rogers has continued her subscription to Nature and Popular Science Monthly. Professor Runkle presented the library during the summer with 34 books and 14 pamphlets, in addition to the most notable gift of all; namely, the greater part of his mathematical library, which was deposited with the Institute during the summer of 1898. This library was fully catalogued before being placed upon the shelves, but as it was at first received as a deposit, and not a gift, it was not entered in the record of accessions. These books are kept together on special shelves in the new and well-equipped room provided during the year for the Mathematical Library.

Changes in the Faculty and Corps of Instruction.

Dr. Adolph Rambeau, Ph.D., has been appointed Professor of Modern Languages to fill the vacancy caused by the death of Professor van Daell.

Dr. Rambeau is of Huguenot descent, and belongs to a French family which fled to Geneva after the revocation of the Edict of Nantes, and afterwards settled in Germany. His collegiate education was at Wittenberg, where he was grounded in Latin, Greek, and mathematics, and his university studies were in classical and Germanic philology, and especially in Romance languages and literatures. He pursued these studies from 1871 to 1874, in 1876, and during different periods after 1876, at Halle, Marburg (Ph.D., 1877; licentiate, 1879), and Paris. Four years, 1874–78, were spent in travelling in southern Europe, Egypt, Algiers, and the United States, and the Italian, Spanish, and English languages were mastered. From 1878 to 1879 he was instructor in the Romance-English Seminary of the University of Marburg, and lectured upon Chaucer and the English literature and language. From 1879 to 1892 he held similar positions at colleges, finally with the honorary title of professor, in Strasburg, Wiesbaden, and Hamburg. In 1891 a linguistic exploration

was made in northern France. In 1893 Dr. Rambeau accepted a call to Johns Hopkins University; in 1894 he became Associate Professor of Romance Languages. He taught French and Italian languages and literatures, and lectured in the graduate department upon comparative phonetics and French pronunciation, and also taught Spanish under the auspices of the public school teachers' association of Baltimore. Dr. Rambeau is one of the editors of a linguistic and pedagogic periodical, and has published a scientific work upon Parisian pronunciation, Chrestomathie Française, also some articles upon Egypt and the East; literary and philological studies upon the "Chanson de Roland," Chaucer's "House of Fame," and Dante's "Divine Comedy"; an edition of old French dramas by Adam de la Hale; educational studies and books for the use of students and teachers; and a great number of articles in American and European philological journals.

Dr. Arthur A. Noyes has been appointed Professor of Theoretical and Organic Chemistry. Dr. Noyes completed our course in Chemistry in 1886. He was appointed Assistant in General Chemistry in 1887, Instructor in Analytical Chemistry in 1890, Instructor in Organic Chemistry in 1892, Assistant Professor of Organic Chemistry in 1894, and Associate Professor of Organic Chemistry in 1897.

Assistant Professors Jerome Sondericker, Allyne L. Merrill, and Edward F. Miller, of the Departments of Applied Mechanics and Mechanical Engineering, have been appointed Associate Professors of Applied Mechanics, Mechanism, and Steam Engineering respectively. Professor Sondericker was appointed Instructor in Applied Mechanics in 1885, and Assistant Professor of Applied Mechanics in 1890. Professor Merrill was appointed Assistant in Mechanical Engineering in 1885, Instructor in Mechanical Engineering in 1887, and Assistant Professor of Mechanism in 1891. Professor Miller was appointed Assistant in Mechanical Engineering in 1886, Instructor in Mechanical Engineering in 1888, and Assistant Professor of Steam Engineering in 1892.

First Lieutenant James Hamilton has been detailed by the War Department and appointed Assistant Professor of Military Science in consequence of Captain Bordman's resignation to become Adjutant of the 26th Infantry, now in service at the Philippine Islands. Lieutenant Hamilton was graduated from West Point in 1890, and has recently resigned from military service and taken up the practice of law.

Mr. Joseph Willard has been appointed Lecturer on Business Law, and will take up the course formerly given by Mr. Brandeis.

Messrs. Carleton A. Read, Frederic H. Keyes, Alexander W. Moseley, and Frederick A. Hannah, Instructors in Mechanical Engineering, have resigned in consequence of favorable opportunities elsewhere. Mr. William J. Drisko, Instructor in Physics, has been appointed Professor at Colby University. Dr. Wendell has returned after leave of absence and resumes the instruction given during his absence by Mr. Drisko. Mr. Charles T. Wentworth, Instructor in History, has also resigned and is now teaching at the B. M. C. Durfee High School in Fall River, Mass. Mr. Myron L. Fuller, Assistant in Geology, has been appointed Instructor. Mr. Francis H. Dike has succeeded Mr. Léon E. Bernard as Instructor in French.

The following Assistants have terminated their connection with the Institute:

Edward M. Bragg,	Frederick L. Edmands,
George M. Holman,	Elbridge C. Jacobs,
Areli H. Jacoby,	Carleton S. Koch,
Louis J. Seidensticker,	Percy G. Stiles,

Robert G. Valentine.

The following new assistants have been appointed:

Henry E. Andrews, A.B., in English.
Charles W. Berry, S.B., in Mechanical Engineering.
Arthur A. Blanchard, S.B., in Theoretical Chemistry.
Fred E. Busby, S.B., in Industrial Chemistry.
William D. Coolidge, S.B., Ph.D., in Physics.
Alvan L. Davis, S.B., in Mining Engineering.

Harrison W. Hayward, S.B., in Mechanical Engineering.
Walter H. James, S.B., in Mechanical Engineering.
Fred. L. H. Kimball, S.B., in Mining Engineering.
William S. Newell, S.B., in Mechanical Engineering.
George H. Priest, S.B., in Oil and Gas Analysis.
George H. Riker, S.B., in Mechanical Drawing.
Norman E. Seavey, S.B., in Physics.
Miles S. Sherrill, S.B., in Analytical Chemistry.
Frank R. Swift, S.B., in Mechanical Engineering.
Etheredge Walker, S.B., in Mining Engineering.
Charles-E. A. Winslow, S.B., in Biology.

William Skarstrom has been appointed Instructor in Gymnastics, in place of H. J. Boos, resigned.

Entrance Requirements.

Solid Geometry has now become an absolute entrance requirement without evidence that it occasions serious difficulty on the part of teachers or applicants.

The number of students passing more than our requirements in modern languages continues to increase, there being 33 applicants who passed Advanced German and 98 who passed Advanced French the present year, while 41 passed both Elementary French and Elementary German.

Scholarships.

The work of the Scholarship Committee of the Faculty has increased this year beyond previous experience. Your Executive Committee assigned for the present year $7,000 from the Austin Fund for undergraduate scholarships. The number of applicants for Institute scholarships up to the present time has been 164, while 137 submitted applications for the 40 State scholarships. Sixty-seven of these made applications in both places, leaving the total number of applicants considered by the Faculty and the State Board of Education 234. Of these 43 have received scholarships to the amount of full tuition, 129 others have received smaller

amounts, averaging somewhat more than $100 each. It may be added that, in accordance with the act of the Legislature authorizing division of State scholarships, 26 of the 40 were so divided, thus increasing the number of recipients to 66.

GRADUATE SCHOLARSHIPS.

The graduate scholars of the current year are Messrs. Lewis B. Abbott, of the class of 1899; W. T. Keough, of the class of 1888; and Clifford M. Swan, of the class of 1899. Mr. Abbott is a candidate for the Master's degree; Mr. Keough is continuing his special work in Naval Architecture; Mr. Swan is a candidate for the degree of Doctor of Philosophy.

FELLOWSHIPS.

Mr. George K. Burgess, of the class of 1896, retains the Savage Fellowship, and is continuing his studies in Paris. The Swett Fellowship, held last year by Mr. Coolidge, of the class of 1895, has been awarded to Mr. Gorham Phillips Stevens, who took his Bachelor's degree in Architecture in 1898, his Master's degree in 1899. Mr. Stevens is now engaged in architectural study in Europe.

The following work has been done by the fellows of last year:

Mr. Herbert W. Chamberlain, of the class of '95, last year appointed a fellow, died on the 26th May, 1899, at Siena, Italy, while pursuing, together with his wife, also a graduate in Architecture, a series of investigations and measurements upon characteristic examples of Italian architecture. The Institute had already received many carefully measured drawings, showing work of great promise, and the deepest regret is felt at Mr. Chamberlain's untimely death.

It has been noted elsewhere that George V. Wendell and William D. Coolidge have completed their fellowship work, and have entered the instructing staff of the Institute.

Dr. Wendell was Assistant, 1892, and Instructor, 1893–96, with a very responsible position in charge of recitations of

the second-year class in physics. In 1896 he was granted the Savage fellowship, and leave of absence, took his Ph.D. degree at Leipsic in 1898, and remained a year longer studying at the University of Berlin. His work in Leipsic was principally in optics, and he presented a research on rotary dispersion for his thesis. At Berlin he investigated the conduction for heat of rarified gases, an important subject in connection with the kinetic theory of gases. A research was also undertaken upon the electric conductivity of bismuth in a magnetic field.

Dr. Coolidge studied Physics and Chemistry at the University of Leipsic, in 1897–99, and during the latter year he was appointed assistant to Professor Drude. He presented as his thesis research dielectric oscillations in wires, and gave an experimental lecture at the Dusseldorf meeting of German scientists on a new method for the demonstration of electrical oscillations in wires.

The Coöperative Society.

A large contribution to the scholarship fund has this year been made from the profits of work by this student society, and they recommend certain of their comrades for the grants of scholarships which are made by a committee of the Faculty. The work is in itself helpful, and consists in supervision of the sale of text-books, drawing materials, and other articles, made by tradesmen affiliated with the society, and the sale of second-hand books belonging to members. Stands for the sale of these articles have been placed for the convenience of our students in several of our buildings. The profits are derived from membership tickets, sales, and advertisements.

The establishment of rules and of forms of contracts has been the subject of much consideration among the student members, and they have been asked by the United States Director of the Department of Social Economy to send an account of their methods of doing business to the Paris Exposition.

New Courses of Instruction.

An optional course in Landscape Architecture has been planned to diverge from the architectural course in the second year, and Mr. Guy Lowell, who graduated from the Institute in 1894, and has recently received a diploma at the French government school of Fine Arts, has been appointed to lecture upon this subject, which he has made an object of special study while in Europe.

In addition to the programme elaborated by our own departments, engineers, landscape gardeners, and architects have been consulted, and our thanks are due for the very carefully considered projects of work which have been made for us. Each author has shown a tendency to multiply studies in his favorite branch, so that the only difficulty has been in reducing the number to a suitable course, of which a schedule will be issued later. A main feature of the new option will be a very thorough course in Horticulture at the Arnold Arboretum, which is under the direction of Mr. Charles S. Sargent. Horticultural and botanical studies in the laboratory and the field will extend through three years, and ample opportunities will be offered not only to learn the habits of trees, shrubs, and plants, but also to study landscape gardening effects in the park of the Arboretum, which is of easy access from our Institute. Excursions will also be made for the same purpose to suitable localities. The engineering practice required for grading, masonry, and other work will be taught, so that correct plans and estimates can be made. Architectural studies and skill in design and composition are most essential parts of the course.

The consultations referred to above give added proof that a course in Landscape Architecture, which has now become one of the professional demands of our country, can be best given in conjunction with a strong school of architecture and engineering, and we are fortunate in being able to establish a connection with the Arboretum, which Mr. Sargent's publications have made known throughout the world as a great horticultural station.

An option in Heating and Ventilation has been added to the three already existing in the Department of Mechanical Engineering. The technical requirements are now so distinctly marked that it has been found advantageous for a mechanical engineer, after he has mastered the earlier parts of the theory of his profession, to decide whether his studies of the fourth year shall turn towards marine engineering, locomotive construction, or mill engineering; and we believe that heating and ventilation has now stepped into a place of similar prominence, and that more extended instruction should be given. We are informed by persons interested in the school that professional situations are awaiting young men equipped in this special engineering branch; and our thanks are due to Mr. J. E. Powell, chief mechanical and electrical engineer of the Treasury Department, Washington, for carefully considered suggestions regarding studies.

Professor Woodbridge will give the new course of instruction in this option, in addition to the shorter course now given at the Institute, and will make the students acquainted with professional practice, by showing them work which he and others are engaged in, and by setting problems in designing plants.

Departmental Reports.

Mathematical Department. — The work of the department has progressed along the usual lines. In the arrangement of work for the present year some changes have attended the discontinuance of instruction in solid geometry, which is now an absolute requirement for admission. An increase in the number of students taking differential calculus has led to a corresponding increase in the number of sections into which the class is divided, from 12 to 14.

Mention was made in the last Report of the preparation of Room 20 in the Rogers Building as a Mathematical Library. The room is now fully furnished, and the members of the department are much gratified at having quarters conveniently and pleasantly situated, handsomely fitted up, and

well adapted in every way to the purposes intended. Ample space in the cases has been provided to allow for the expected growth in books and models during a number of years, while the plan is such that the cases can readily be extended whenever needed.

The Library has just received a most notable increase in the number and importance of its volumes through the generous gift by Professor Runkle of his entire collection of books in Mathematics and Astronomy. This collection consists of about 450 volumes, besides many pamphlets and monographs, and contains numerous rare and valuable treatises that are now difficult to obtain. It comprises also many of the early numbers of mathematical journals, and a very complete collection of text-books illustrating the progress and development of the teaching of elementary mathematics in this country during the past seventy years. In recognition of Professor Runkle's long and eminent service as a senior member of the mathematical department, and of his generous interest in the library, it has been named by the Executive Committee "The Runkle Library of Mathematics." By means also of the special appropriation last year and a needed increase in the annual appropriation, the library is now in excellent condition to meet the needs of our Faculty and students. The following periodicals are regularly received:

Acta mathematica, American Journal of Mathematics, Bulletin of the American Mathematical Society, Annals of Mathematics, Bulletin des sciences mathématiques, Journal für die reine und angewandte Mathematik, Journal de mathématiques elementaires, Journal de mathématiques pure et appliquées, Mathematische Annalen, Messenger of Mathematics, and Quarterly Journal of Mathematics Pure and Applied.

Courses I. and XI., Civil and Sanitary Engineering. — The new arrangement of the rooms of the department affords ample accommodation, and the work can now be carried on with greater efficiency than ever before. In particular, the collec-

tions of photographs, drawings, and samples of material are now rapidly increasing. During the past year the department has received the following gifts: One thousand three hundred and ten blue prints; eighteen framed photographs; seventy unframed photographs, among which is a set of twenty photographs of engineering work in Vienna, received from Prof. F. von Emperger, and an album of twenty-three large photographs from the Gütehoffnungshütte, in Germany; four hundred and forty-nine charts from the United States Coast and Geodetic Survey; and eight charts from the United States Geological Survey. A large number of samples of building materials have been received from various firms and individuals. Particular mention should also be made of a gift to the department from Mrs. E. H. Faucon, of Milton, Mass., in memory of her son, Gorham F. Faucon, of a large number of valuable engineering books and of one hundred and eighty-two sheets of foreign plans and maps of great interest. An impulse wheel, three feet in diameter, with fittings, has also been presented to the Institute by the American Impulse Wheel Company of New York, through the courtesy of Mr. A. V. Garratt, Engineer of the Lombard Water Wheel Governor Company. In addition to the persons who have thus contributed, the thanks of the Institute are due to President Tuttle, of the Boston & Maine Railroad; W. H. Barnes, General Manager of the Boston & Albany Railroad; and A. C. Kendall, General Passenger Agent of the New York, New Haven, & Hartford Railroad, for courtesies of various kinds. The department has also purchased a large number of new instruments for use in surveying and hydraulics, including four new plane tables, a new current meter, several barometers, and numerous smaller instruments. The equipment of the geodetic observatory has been increased by the addition of a dip circle and by two special switch-boards to be used in connection with longitude determinations. The collection of photographs of the department has also been increased by the purchase of over fifteen hundred new photographs and a large number of new slides.

The range of occupation open to graduates in this department is steadily increasing, and at the present moment the demands upon us for engineers show that a much larger number could find immediate employment. Even during the years of business depression, the department each year had more applications for men than it was able to supply, and during the past year the demand was greatly increased.

SUMMER SCHOOL OF THE CIVIL ENGINEERING DEPARTMENT. — The twelfth summer school was held at Cherryfield, Me., in June last, and was attended by twenty-five third-year students, the largest number that has ever attended any summer school of the department. The work was in charge of Professors Burton, Porter, Robbins, and Barton, and Instructors Sweet and Hosmer, with the assistance of Messrs. Parker and Clapp of the class of 1899.

The party left Boston June 8th and returned July 8th. Three weeks were spent at Cherryfield, Me., devoted to work in geodesy and hydraulic measurements. A base line was measured and a system of triangulation developed which was used as a basis for a plane table survey on a scale of 1 to 5,000, with contours at intervals of ten feet. A square mile of territory was mapped in this way, including the five dams on the Naraguagus river. The discharge of the river was determined by the use of floats and current meters, and the meters were rated in still water. The elevation of the crests of the different dams above mean high water was measured, thus enabling the gross horse-power at this point in the river to be computed. Meteorological and tidal observations were taken at Milbridge, a short distance from Cherryfield on the coast. A plane table survey was made of Milbridge harbor and about a hundred soundings taken, locating the channel. A visit was made to the old Epping base of the United States Coast Survey, which was measured in 1857.

At the close of three weeks of surveying, a geological excursion was taken under the direction of Professor Barton. The party spent a day at the Joggins Coal Mine in Nova

Scotia, visited iron and gold mines near Halifax, and after a very interesting and instructive trip to the points of geological interest arrived in Boston July 8th.

An appropriation has been made to send Professor Burton and a small party to Georgia in the middle of May to make time observations in connection with the total solar eclipse of May 28th. The equipment of the geodetic observatory will be used in these observations, and in addition an arrangement has been made for the loan of two 5-inch Clark telescopes with mountings.

Course II., Mechanical Engineering. — A planer has been added to the equipment of the engineering laboratories and this, together with the engine lathe and speed lathe which we have already, will enable us to have some of our machine tool work done at the Institute instead of outside.

A three-stage air compressor has been ordered, having a capacity of 100 cubic feet of free air per minute, which it can compress to a pressure of 2,500 pounds per square inch. In consequence, however, of the great activity in all kinds of business it has not yet been delivered.

Attention is called to the facilities offered by the following firms to our students doing Thesis work:

Through the kindness of Mr. Hayden, the Vice-President of the Boston & Albany Railroad, Messrs. B. S. Hinckley and H. A. B. Campbell were enabled to make for their thesis a series of economy tests of a two-cylinder compound locomotive recently built for the road. The locomotive was a twelve-wheel engine carrying heavy freight which exerted, on an average, about 600 horse-power, and at times more than 1,000 horse-power. The tests involved the determination of the horse-power developed, and also of the coal and water consumption in each of six runs from Albany to Springfield.

By the courtesy of Col. E. D. Meier Mr. H. L. Morse was enabled to make a series of tests of a Diesel motor which was on exhibition at the fair of the Massachusetts Charitable Mechanic Association.

The publication of the results of tests in the "Technology Quarterly" has been continued; No. XI. was published in Vol. XII., No. 3, of the Quarterly in September, 1899. The following publications have been made by members of the department, viz.:

A new and revised edition of the Notes on Dynamometers, Planimeters, Governors, and Fly Wheels, by Professor Lanza.

A new edition of the Notes "Illustrations of Engines and Machines," by Professor Peabody.

Two articles on "Testing" in "Machinery," by Professor Miller.

APPLIED MECHANICS. — The range of tests made in the laboratory of Applied Mechanics during the past school year involved:

Tension of high carbon steels.
Crushing strength of brick.
Tests of iron and steel in tension.
Tests of aluminum.
Crushing of 2-inch cubes of cement.
Transverse tests of wrought-iron bars.
Tests of aluminum wire.
Tests of steel wire.
Torsion of $1\frac{1}{16}$-inch diameter cold rolled steel shafting.
Torsion of aluminum rods and wire.
Torsion of steel rods and wire.
Tests on strength of rope.
Tests to find efficiency of knots for holding rope.
Transverse tests of spruce and yellow-pine beams.
Testing cement in tension.
Mixing cement for testing.

The space gained in the laboratory has also enabled us again to pursue investigations upon the effect of applying the load to timber beams for a long time.

SHOPWORK. — The total number of students receiving instruction is 238. Many of these take more than one course, and they are divided among the different classes as follows:

Carpentry and Wood Turning	104
Forging	95
Chipping and Filing	72
Machine Tool Work	42
Metal Turning	47
Pipe Fitting	4
	364
Students taking work in two or more classes and counted more than once	126
	238

The total number in 1897–98 was 210; in 1898–99 it was 231.

The Machine Shop now accommodates 23 students, and the class now taking the machine tool work in two sections numbers 42. Had there been no summer course it would have been impossible to accommodate all applicants this year. Should the number of students taking the work continue to increase it is probable that arrangements will need to be made for a greater number of sections or for increased equipment in the crowded departments.

The improvements made last year have been of great advantage. The instruction room for the machine-shop has proved so convenient that similar rooms are recommended for the wood-working and forging departments. The equipment remains essentially the same as for last year. It is hoped, however, to add a turret lathe to the machine shop equipment before the end of the school year.

Course III. Mining Engineering and Metallurgy. — The whole lower floor of the Rogers Building is now used by this department, and the work is conducted to great advantage. The lecture charts and specimens are within easy distance of the lecture-room. The lecture-room, library, laboratory, and offices can all be quickly reached from each other. As a result of these new facilities the thirty-one members of the present large fourth-year class, in the mining and metallurgical laboratories, are carried through their studies with relatively greater ease than the smaller previous classes, and are receiving a better course of instruction. The class is

divided into three sections. Professors Richards, Hofman, and Lodge take charge of a section each for a week in rotation. By this arrangement every student in the class has either taken a part or performed the whole work in eighteen different processes or experiments, distributed over ore-dressing, roasting, smelting, amalgamating, and leaching.

The arranging and labelling of the collections of ores and metallurgical products has been interrupted by the great demands of the laboratory. This work will be continued as time is found for it.

The ore-dressing laboratory has received the following additions to its plant: an Embrey belt vanner, which can be used either for the ordinary vanner work or for the special work of concentrating extremely fine slimes; a Wilfley table, which will introduce the student to this new and most useful class of concentrating tables. The assaying room has received large additions to its furnace plant, and now has twenty crucible furnaces, thirteen muffle furnaces, and a new oil burner muffle furnace.

Professor Richards' book on Ore Dressing is now in the hands of the printers.

A new edition of Professor Hofman's book on Lead has been issued.

Professor Lodge's new lithographic notes on Assaying are now ready.

THE SUMMER SCHOOL OF METALLURGY was this year held in New Jersey and Pennsylvania. Visits were made to smelting works and mines. The former were given the most prominence; the party numbered ten, including Professors Richards and Hofman, together with eight members of the second, third, and fourth year classes in mining engineering. At Bergen Point, N.J., the smelting and refining of copper was studied at the works of the Orford Copper Company. The blast furnaces, the open hearth department, the shops for making guns and armor plate of the Bethlehem Iron Works were inspected at Bethlehem, Pa., and the manufacture of spelter and zinc-white was studied in the

works of the New Jersey Zinc Company. At and near Pittsburgh, Pa., the party made studies of blast furnaces in Shoenberger & Company's works and in the great Duquesne plant of the Carnegie Steel Company, Limited; of Bessemer steel plants at Jones and Laughlin's and at the Edgar Thompson works; of open hearth steel plants at Shoenberger's and at the Homestead Works; of the manufacture of iron tubes at the National Tube Works; of fire bricks at the works of Harbison and Walker; of puddling at the Sable Iron Company's works; of wire rolling and drawing at the American Steel and Wire Company's works; and of crucible cast steel at the Crescent Steel Company's works. The party visited the coal mine of the Essen Coal Company, where electric machinery has been largely introduced.

The thanks of the department and of the Institute are due to the gentlemen in charge of the above works for the kind and sympathetic interest taken in the students, to whom the freedom of the works in each case was cordially granted.

Course IV., Architecture. — Since the last report no changes have been made in the arrangement of studies of the regular course.

The option in Architectural Engineering introduced last year is now well under way, and will present an excellent class for graduation next spring.

The recently created option in Landscape Architecture offers opportunity for study in new directions, and is a distinct step in advance. The course of study is the result of the fullest coöperation between the Institute and practising landscape architects of the highest rank in their profession. The value of this assistance will be better understood when it is known that no precedent exists on which to base such a course, and that the prescribed studies represent the result of personal experience during years of active practice. The schedule of studies in this option has been under consideration for some time and now approaches complete form. Next term the department will be prepared to receive students in the second-year work of this option.

Although no change has taken place in the titles of the studies of the regular course, considerable internal change has been developed in the professional courses. Among these improvements may be mentioned the free use of lantern-slide illustrations for all lectures, the addition of valuable details to the courses in history of architecture and construction, the frequent use of models instead of casts for freehand drawing, and the better draughtsmanship shown by the classes in design. It has, however, been felt for some time that closer correlation is needed in the professional work of the different years, and that the more complete study of the later periods of the history of architecture should be introduced as soon as possible.

The greatest addition in equipment is due to the purchase last summer of sixty-five casts of Roman architecture, which offer excellent opportunity for the study of good antique and renaissance detail. Part of these casts are now temporarily placed in the studio and library, awaiting the arrival of the larger fragments that are to be specially made for the department. Among the large casts are the full-size section of the cornice of the temple of Castor and Pollux in the Roman forum, the order from Trajan's arch at Beneventum, and a portion of Sansovino's monument to Cardinal Girolamo Basso della Rovere in the Church of Santa Maria del Popolo at Rome.

The Library is improved each year, and although few expensive books have been added lately, new photographs to the number of 2,900 have been added and are now being put in circulation, 3,000 old photographs have been remounted on cards of uniform size, 400 lantern slides have been added to our previous large collection, and a new and enlarged card catalogue provided for the use of students and instructors.

In the Exhibition Room, in addition to the continuous display of drawings, large numbers of photographs and diagrams of historical importance are arranged each week to illustrate the regular lectures and to assist students to a working knowledge of architectural precedent.

At the request of the department the visiting committee from the Boston Society of Architects has been changed from nine to three members, the committee consisting this year of Mr. Robert S. Peabody, Mr. R. Clipston Sturgis, and Mr. Philip Hale. Because of Mr. C. Howard Walker's absence in Europe, Mr. Walter H. Kilham is giving the lectures of the course in history of ornament. Mr. Harry W. Gardner, Instructor on leave of absence, and Mr. George P. Stevens, the holder of the Swett fellowship, report progress of studies in the north of Italy, and that several measured drawings have been made as "envois" in Bologna and Florence.

The department mentions with deep regret the death at Siena, Italy, last June, of Mr. H. W. Chamberlain, one of our most conscientious and loyal graduates. Mr. Chamberlain was working under the direction of the department, and had sent home one set of drawings made in Rome. His remaining sketches and measured drawings are now being drawn in formal manner by Mrs. Chamberlain, and will be given to the Institute.

A large number of our graduates desire to continue their studies abroad and a year's architectural study and travel in Europe forms an excellent continuation of the regular course and the benefit, direct and indirect, is great when the studies are properly directed under scholarship supervision. The Perkins graduate scholarship is devoted to this purpose and a part of the Austin fund is available, but other foundations would render great aid to the Architectural department.

The Rotch prizes given annually to students in the department were this year awarded to Mr. L. B. Abbott and Mr. J. F. Clapp.

SUMMER SCHOOL OF ARCHITECTURE. — The Summer School of Architecture this year had a very profitable European tour. Starting from Genoa, two weeks were spent in Milan, Brescia, Verona, and cities of north Italy, including a five days' visit in Venice. After a quick return from Venice

to Genoa the party began its bicycle ride along the western Riviera to Paris through Mentone, Monaco, Nice, a section of the Maritime Alps, Frejus, and Toulon to Marseilles. Then turning north, two weeks were spent in the Rhone Valley visiting Aix, Arles, Nîmes, Avignon, and many architecturally interesting towns, finally leaving the valley at Viviers for the climb over the Cevennes mountains to the higher levels of the Puy de Dôme region, — a very interesting trip through sections seldom visited by tourists. Passing through Riom, Vézelay, Sens, Moulin, Nevers, Bourges, Troyes, and Fontainbleau, the school reached Paris in good condition on August 10th.

Much hard riding was encountered in the mountains of the Riviera and the Cevennes and in pushing against the strong head winds in the Rhone Valley, but these hard days were offset by many delightful rides.

Measured drawings were made at Venice and Arles, and sketches were made in most of the towns visited. Over 700 negatives were taken with hand cameras of important details, interesting buildings, and local scenes. The successful pictures will be added to our library collections of photographs and lantern slides, filling up many vacant spaces. The school passed through very rich architectural regions, and profited greatly by observation and local study. It is only to be regretted that more students could not take advantage of the opportunity.

Courses V. and X., Chemistry and Chemical Engineering. — No important changes have been made in these departments, and the rearrangement of rooms made in the summer of 1898 has proved as satisfactory as was predicted last year. Owing to the increased size of the classes, the corps of chemical instructors has been increased by the appointment of two new Assistants in Analytical Chemistry and Theoretical Chemistry respectively.

A ventilating fan, driven by an electric motor, has been placed on the roof of the Walker Building and connected with the flues leading from the hoods in the laboratories of organic

chemistry on the fourth floor, and of analytical chemistry on the third floor. By means of this fan a much larger volume of air is drawn into these laboratories than formerly, and as this is made to pass out through the hoods, a marked improvement in temperature and ventilation of the room and in the working efficiency of the hoods has been the result.

The first-year laboratory has been renovated and improved by wholly renewing the drainage system, putting new tops upon the laboratory benches, adding 80 permanent lockers in place of the same number of temporary lockers, and substituting open top gutters for sinks. This includes the renewal of the platform and all the piping.

A short course in shopwork has been arranged for Course V. designed to familiarize the student with the common tools to enable him to construct or repair the usual chemical apparatus.

It is pleasant to note that there is an increasing appreciation of the value of the William Ripley Nichols Chemical Library, as shown by the number of persons who consult it, and their often enthusiastic commendations of its completeness. The additions of the important chemical publications of the year have been made, as usual.

ORGANIC CHEMISTRY. — Twenty-nine students are working in the laboratories of organic chemistry.

A room has been equipped as a tool-room for the use of the Chemical Department, and is fitted with a power lathe run by an electric motor, and with an ample supply of tools for the work required to be done. Another room has been equipped as a "dark-room" for photographic work, and is proving itself most valuable.

The room adjoining the Kidder Chemical Lecture-room, formerly used as a store-room, has been partitioned off so that one-third serves for the preparation of experimental lectures, and the remainder, a space of 16 × 30 feet, is now used as a special research laboratory and is provided with electrolytic apparatus beside the usual laboratory fittings. It is now occupied by one of the Instructors in Organic Chemistry

and by two graduate students, one working on the atomic weight of tellurium and the other on a special organic investigation.

ANALYTICAL CHEMISTRY. — The total number of students taking analytical chemistry is 145, of whom 77 are taking qualitative and 68 quantitative analysis at the present time. This is a slight increase over the total number of last year, and is nearly sufficient to fill the two laboratories of analytical chemistry.

It is interesting to note that the number of students who present evidence of having had sufficient training in chemistry in the secondary schools to admit of excuse from the work in general chemistry of our first year is gradually increasing. Twelve such students have been admitted to the classes in analytical chemistry this year, and are carrying on the work of the course successfully. Such of these students as are anticipating the chemical courses of the later years will, in many instances, desire to take more extended courses in inorganic chemistry in the time thus gained, and questions relating to their instruction and accommodation will probably soon present themselves for consideration.

No changes, except in details, have been made in the methods of instruction in analytical chemistry during the past year. The services of an additional Assistant in the instruction of the advanced students became a necessity as a result of the large number in these classes.

A valuable microscope, especially equipped for use in the examination of metals, has been added to our equipment, and Dr. Fay has devoted much attention to metallographic work during the past year, including the direction of thesis work of this character.

The Laboratory of Sanitary Chemistry has been fitted with electric heaters for the Soxholet extraction apparatus, thus avoiding the danger from fire in the use of ether and gasolene. There has also been installed a specially designed still for the supply of doubly distilled water for the use of the Chemical and Physical Departments in conductivity experi-

ments and water analysis. The Notes in Sanitary Chemistry are to be published in the spring under the title "Air, Water, and Food."

The laboratory for Oil and Gas Analysis has received a fine collection of essential oils from Fritzsche Brothers and Dodge & Olcott, of New York.

For work in sugar analysis a Scheibler saccharimeter has been purchased.

TEXTILE COLORING. — The new Textile Coloring Laboratory is found to be in every way a great improvement over the old one. The lighting of this room with north skylights, thus avoiding direct sunlight and reflected light from colored objects, enables the student to match colors for dyeing to shade with greater ease and precision than could be done in the old laboratory. Eleven students took the textile coloring option last year, which includes about thirty lectures and sixty hours of laboratory work.

During the term visits were made by the class to the Robert Bleakie Co., Woolen Mill, Hyde Park, Mass., Mr. C. F. Allen, Treasurer, and to the Middlesex Dye, Bleach, and Print Works, Somerville, Mass., Mr. George L. Gilmore, Superintendent, to whom thanks are due for courtesies.

INDUSTRIAL CHEMISTRY. — Thirty-eight students worked in the new laboratory last year. Its superior ventilation was fully demonstrated during the year. A small ore crusher has been added to the equipment of the laboratory.

The class attending lectures upon Industrial Chemistry numbered forty-three, and the instruction comprised sixty-seven lectures and nine written and oral recitations. The usual number of lectures were given by gentlemen not connected with the Institute, and excursions made to the following works: Curtis Davis Soap Company, Cambridgeport, Mr. E. D. Mellen, Treasurer, Mr. J. W. Loveland, Manager; Farwell Bleachery, Lawrence, Mr. Kirke W. Moses, Agent; International Paper Company, Russell Mills, Lawrence, Mr. Hugh J. Chisholm, President, Mr. G. F. Russell, Manager; Lewis' Wool Scouring Mill, Lawrence, Mr. H. Bradford Lewis,

Superintendent; Malden Gas Works, Malden, Mr. Thomas H. Hintze, Superintendent; Merrimac Chemical Works, South Wilmington, Mr. A. P. Howard, Superintendent, Mr. H. Howard, Assistant Superintendent; Union Glass Company, Somerville, Mr. J. de Cordova, President. The Institute is under obligations to the above-named gentlemen, and to Mr. D. J. Flanders, General Passenger Agent of the Boston & Maine Railroad, for courtesies extended to our students in connection with these excursions.

The new lecture-room in the Henry L. Pierce Building has proved very satisfactory as to lighting and acoustics. It is arranged for the exhibition of lantern slides, but the darkened room causes difficulty in taking notes; consequently one hundred and twenty-five India-ink drawings and about seventy charcoal sketches have been prepared by Dr. Thorp, all sufficiently large to serve as wall charts, and their use has been found much more satisfactory than lantern slides.

A fund generously provided by Mr. Samuel Cabot has enabled Dr. Thorp to spend the summer in visiting the principal chemical manufactories of England, France, and Germany.

BOOKS PUBLISHED. — Thorp, F. H.: Outlines of Industrial Chemistry (second revised edition).

Richards, Ellen H.: The Cost of Living as Modified by Sanitary Science.

Gill, A. H.: Gas and Fuel Analysis for Engineers (second revised edition).

Gill, A. H. (compiler): A Register of Publications of the Institute (supplement to the third edition).

ARTICLES PUBLISHED. — A. A. Noyes: 1. Die Beziehung zwischen osmotischer Arbeit und osmotischem Druck.

2. Die thermodynamischen Ausdrücke für die Lösungs- und die Dissociationswärme von Elektrolyten.

Richards, E. H.: The Relation of the Higher Educational Institutions to Commercial and Expert Work.

G. W. Rolfe and George Defren: Manufacture and Use of Brewing Sugars.

S. P. Mulliken and H. Scudder: A Simple Color Reaction for Methyl Alcohol.

Whitney, W. R.: The Nature of the Change from Violet to Green in Solutions of Chromium Salts.

Woodman, A. G.: On the Determination of Added Water in Milk.

Courses VI. and VIII., Electrical Engineering and Physics. — In these courses there has been continued development in various directions. The lectures in General Physics in the second year have been materially aided by the addition of much new apparatus for demonstration, especially in electricity and light. A serious difficulty in connection with these lectures is that while there has been a vast increase in the number of topics that must be considered at length even in a course for beginners, the allotted number of exercises is no greater than it was twenty years ago. Some relief is afforded by the fact that about eighty per cent. of the students have studied physics to some extent before entering the Institute, which was not formerly the case; so that a more philosophical treatment of the subject is possible, while the recitations also allow of the omission of certain of the less difficult topics from the lectures.

The last year closed the connection with the department of Mr. Wm. J. Drisko, who has recently been appointed to the chair of Physics at Colby University. He resigned his position of Instructor in Physics after having taken charge of the recitations for the past three years. Mr. Drisko has been singularly successful in this onerous work, and has won the respect alike of his pupils and colleagues. During the present year the recitations in physics are again in charge of Dr. Wendell, who has returned from a three years' course of study in Leipsic and Berlin.

The Laboratory of General Physics has acquired several valuable pieces of apparatus during the past year, among which may be mentioned a Zeiss comparator, a Zeiss spherometer of novel construction, a Michelson refractometer, and a Rowland concave grating with mounting for photographing

the spectrum. A new photometer room has been fitted up for work with the spectrophotometer and Weber photometer.

The introduction of physical laboratory work into the Course in Chemistry in the second year, with lectures at the same time on physical measurements as previously arranged for Courses VI. and VIII., has proved of decided advantage to the students, and a like arrangement for all the engineering courses is very much to be desired.

The enlargement of the Physico-Chemical Laboratory mentioned in last year's report has greatly facilitated the instruction given therein. A large electrically heated and regulated thermostat six feet by three feet has been devised and added to the equipment of the laboratory, by which a great saving of time is effected for the students by allowing various lengthy operations to be carried on continuously during the night.

The work in this laboratory suffers from the necessity of having to accommodate classes and students working on theses at the same time. Special rooms for investigation for students taking physical theses are very greatly needed.

In the Laboratory of Electrical Measurements a number of new experiments have been introduced and the purchase of additional apparatus has allowed of much improvement in others. An important addition is that of two small specially constructed dynamos of high voltage for testing and calibration of instruments, and also a set of standard resistances of large carrying capacity standardized at the German *Reichsanstalt*. These constitute a portion of a complete set of calibration apparatus now being designed and constructed in the Rogers Laboratory, which when completed will allow of exact verification of electrical measuring instruments for both direct and alternating currents throughout the widest range. Beside these there have been added several Wheatstone bridges, a Rowland electrodynamometer and an apparatus designed in the laboratory for photographic study of the form of alternating current waves. The amount of instruction called for in this laboratory has been greatly increased by the

recent introduction of a large amount of advanced work for the students in the chemical courses.

In the Laboratory of Electrical Engineering much new apparatus has been added, this being largely made within the department. Worthy of special mention are a set of model lecture apparatus for illustrating the behavior of polyphase motors and compensators, and a set of transformers designed to show the various possible combinations and connections, and to exhibit their effect. Also worthy of notice are a new apparatus for the stroboscopic study of the alternating current arc, and a collection of arc-lamps of various types for testing. There is at present in process of construction in the laboratory an assemblage of apparatus for familiarizing the students with the various special methods of testing polyphase alternating current machinery. This comprehends eight or ten instruments and transformers built expressly for the purpose, together with a switch-board of peculiar construction.

During the last year the lack of sufficient engine power in the dynamo room has been seriously felt. The rapid and excessive increase in the call for electricity for purposes of general illumination has at times exceeded the available power, so that serious and on occasions even dangerous overloading has occurred. A partial remedy has been provided by an enlargement of the supply mains from the Edison system. There is abundant dynamo capacity for all present needs, but a new engine will be necessary to secure the proper illumination of the Rogers and Walker Buildings.

The increased space which was allotted last year to the Laboratory of Heat Measurements has allowed of much improvement in the instruction; indeed, without such enlargement it would have been physically impossible to give the instruction called for. Notwithstanding the advanced character of the work it is at present taken by about seventy-five students, miners, chemists, and physicists. The equipment of the laboratory has been greatly increased and is now

excellent, including much apparatus of original design and construction.

Two new optional courses of lectures have been established in the department, not required, but open to students approved by the Faculty. The first of these, by Mr. Louis Derr, is devoted to Calculating and Computing Machines, their theory and use, and is intended to lead the students to a more extended use of such aids to computation. A second course is upon the Applications of Polarized Light in Physics and Chemistry, by Dr. George V. Wendell. This will contain a full discussion of the theory and construction of different forms of polarimeters, saccharimeters, and other similar apparatus, and of their various applications.

At the present time the department is contemplating the presentation to the Faculty of a modification of the course in Physics — Course VIII., — which will give to students desiring it a better preparation than is at present available either at the Institute or elsewhere for entering upon the practical applications of electro-chemistry. Such a preparation calls for a larger amount of pure and applied chemistry than is properly given in a course in Electrical Engineering, while certain branches that are important in the latter course are not especially needed.

The department is still greatly cramped for room, a want which is well understood by the Corporation, and upon which I need not enlarge.

Books Published.

H. M. Goodwin: The Fundamental Laws of Electrolysis (Harper's Science Series).

L. Derr: Notes on Dynamo Design.

L. Derr: Notes on Methods of Telegraphy.

Articles Published.

S. H. Woodbridge: Congressional Report on Ventilation of House of Representatives, Washington.

S. H. Woodbridge: Report to Public Health Association on Car Sanitation.

S. H. Woodbridge: Car Sanitation, Paper read to New England Railroad Association.

S. H. Woodbridge: On the Ventilation of Audience Halls. Series of papers now issuing.

H. M. Goodwin and G. K. Burgess: The Osmotic Pressure of Certain Ether Solutions and its Relation to Van't Hoff's Law.

H. E. Clifford and J. S. Smyser: The Acetylene Standard of Light.

C. L. Norton: On the Rapid Measurement of the Tensile Strength of Cotton Fibres.

R. R. Lawrence: On an Automatic Mercury Pump.

H. W. Smith: On a Method of Measuring the Frequency of Alternating Currents.

Course VII., Biology. — The relief felt by removal to comfortable and spacious quarters in the new Henry L. Pierce Building has in this department been very great. The year's work was somewhat broken by the unavoidable delays in completion of the several laboratories, but this was more than made good by the greater convenience, during the last half-year, and especially at the beginning of the present year. Experience has proved that the general arrangement and equipment of the biological laboratories is in every case but one entirely satisfactory. Professor Sedgwick states that "the lighting and coloring are admirable; the relative absence of dust and noise is most welcome; the construction and furnishings are substantial and suitable." The bacteriological laboratory alone has proved to be unsatisfactory. Owing to the increasing size of the classes and the number of special workers in this subject and in sanitary and industrial biology, all carried on in the same room, this laboratory is already crowded. It is hoped that as soon as possible a more spacious room, or set of rooms, may be provided for this work.

The growing importance of practical laboratory work upon the theories and the arts of the purification of sewage and

water by natural and artificial processes, not only for biologists but also for chemists and engineers, has led Professor Sedgwick to urge the immediate construction of a special sanitary laboratory on the site of the present bicycle shed, in the court-yard of the Trinity-place buildings. He advises that such a laboratory be modelled on a small scale somewhat after that maintained for the last twelve years by the State Board of Health at Lawrence under the direction of a distinguished member of our corporation, Mr. Hiram F. Mills. In a laboratory of this kind those of our students who desired to do so might become practically familiar, by actual experiments, with the principles and processes which the Lawrence Experiment Station has worked out for the benefit of engineers and sanitarians; and if such a laboratory should be built it might well be made two stories high, the lower — like the Experiment Station in Lawrence — largely underground, the upper well lighted and suitable for classes in bacteriology and sanitary biology, including opportunities for some chemical work upon sewage and water.

The usual work of the department on the sanitary side has been continued by Professor Sedgwick, and an important piece of research has been completed under his direction by Mr. C.-E. A. Winslow, a graduate in Biology in 1898, who made this work the basis of his thesis for the degree of Master of Science in June, 1899. The investigation is entitled "Experimental and Statistical Studies on the Influence of Cold on the Bacillus of Typhoid Fever and its Distribution; with special reference to Ice Supply and the Public Health."

The course in Industrial Biology, comprising the practical application of bacterial and other microörganisms of fermentation to various technical and manufacturing processes, increases steadily in scope and importance. Its object is two-fold: first, to teach the application to the industries of useful organisms in their most important rôles; and second, to give some knowledge of organisms which may cause trouble in industrial processes, and to provide methods for their control or destruction. The theory of fermentation

is dwelt upon in detail, especially in the light of recent advances in our knowledge of the chemistry of enzymes. This course affords a common meeting ground for the practical biologist and the technical chemist. The students examine and study the action of the microörganisms in question, and, on a small scale, carry on some of the processes as these are used commercially. The relation of bacteria to sundry transformations in Nature which have a direct industrial or economic bearing — such as the fixation of nitrogen, nitrification, and oxidation — is also considered. The work on the improvement of processes of food-preservation, begun three years ago by Mr. S. C. Prescott of this department and Mr. Wm. Lyman Underwood, has been continued with valuable results. These were in part embodied in a paper presented at the joint meeting of the Atlantic States and Western Packers Associations at Detroit, in February last, the largest meeting of men engaged in the food-preserving industries ever held in this country. The work of Messrs. Prescott and Underwood is regarded as of so great value to these manufacturers that for the third year in succession Messrs. Prescott and Underwood have been asked to give some of the results of their investigations before these annual meetings.

While much of the work of this department is now directed towards the applications of biology to sanitary and industrial processes and their improvement, the fundamental basis of these and similar applications in its more purely scientific aspects is not neglected. An important part of the work in physiology continues to be directed toward the proper understanding of the problems of personal hygiene, and with each year the efficiency of this portion of our work is increased. There is a field for physiology as well as for bacteriology outside the very important one which each fills in the medical school. Year by year the attention given to practical problems of hygiene is increasing, and the solution of these problems must come not merely from physicians, but from physiologists as well. This is notably the case, for ex-

ample, with the important matter of school hygiene, which must take account of such physiological questions as physical training, fatigue, heating, lighting, ventilation, and the like, questions which can be solved only with the coöperation of those who are connected with school work and who have at the same time had proper training in applying scientific principles to the solution of the questions in hand. Professor Hough continues his studies on the physiology of muscular exercise, and together with Miss Ballantyne, a graduate of this department in 1899, has made investigations upon the effects of changes in external temperature upon the circulation of the blood in the skin. A preliminary report of their results has been published.

The only changes of importance in the staff of this department are the resignation of Dr. George M. Holman, Assistant, after two years of faithful service, and in the appointment in his place of Mr. C.-E. A. Winslow.

Course IX., General Studies. — In the work of this department there has been but little change during the past year. A new option is being given by Professor Sumner on Politics of Eastern Asia. Particular attention is given to recent commercial and trade developments. A graduate of this course, class of 1899, Amasa A. Holden, was awarded the first prize of $150 by the American Protective Tariff League for an essay on "The American Merchant Marine: its Restoration by Means of Discriminating Duties." During the early part of the year Professor Dewey was a member of a committee of the American Economic Association which made a report on the Federal Census, with a view of improving the methods of this administrative work of the United States government. He has also edited General Walker's miscellaneous writings on political economy in two volumes, entitled "Discussions in Statistics and Economics." Professor Ripley has also brought out in final form his essays on anthropology in a volume entitled "The Races of Europe." This is accompanied by a supplementary volume entitled "A Selected Bibliography of the Anthropology

and Ethnology of Europe," published by the Trustees of the Boston Public Library. The latter volume offers an interesting example of the co-operation of expert service with an important branch of the municipal government of Boston. Especial mention should be made this year of the commendable work of the Walker Club, an organization of students of the Course in General Studies, in the successful bringing out of a play which netted over $600 in aid of the Walker Memorial Gymnasium Fund. This play was managed entirely by students, and, although given once outside of Boston, as far as observed did not interfere with the regular school work.

The advance in English work, which has during recent years shown itself in secondary schools, enables the instructors in the English Department to appeal with more and more confidence to the intelligent interest of students. Each year there are more men from various courses who wish to enter the classes in advanced composition and literature, with a wide recognition of the value of such work to students of technical branches.

For some years the department has given to fourth-year students in mining engineering a course known as "Memoirs." It consists of a thorough revision of the English of abstracts made from technical articles in French and German magazines. The course thus has the threefold purpose of putting the student in touch with the work of foreign experts in his own profession, of keeping his knowledge of modern languages in working condition, and of giving him regular practice in the accurate use of English in connection with his special line of work. A similar course is to be given to first-year students in architecture. They will be required to read in French selections from the work of the best writers on architectural subjects, and to write essays on topics suggested by these articles. This written work will be criticised for English. This extension of the work of the department is gratifying, because it is by thus working in conjunction

with other departments that English composition may be most successfully taught in a scientific school.

In the October number of the " Technology Review " was published a paper by Mr. R. G. Valentine, recently an instructor at the Institute, giving an account of the work of the department in English composition, and the original methods which have, with good success, been devised and put into practice.

Course XII., Geology. — One year ago the working force of the Department of Geology was busily engaged in getting the specimens and the appliances for teaching into places where they may be readily obtained for use. Since that time good progress has been made toward a systematic arrangement of the collections so as to make them most serviceable in the work of teaching. Professor Crosby has so rearranged the petrologic and lithologic collections and a considerable portion of the mineralogical collections in over four hundred wooden trays that they are constantly ready to be placed before classes and thereby furnish each member a distinct series for individual study. Also a considerable amount of work has been accomplished in the numbering and labelling of the specimens of minerals, and these may now be freely used without danger of losing a record of their locality or other facts concerning them, and much has been done in the classification of the fossils, and progress has been made in the identification, numbering, labelling, and cataloguing the specimens.

The books of the Geological Library have been numbered and classified, but work remains to be done to complete the cataloguing.

The Geological Department, through two of its representatives, has had an opportunity of coöperating with the United States Commissioners to the Paris Exposition and the Massachusetts Board of Paris Exposition Managers in gathering collections of minerals and of building stones of the United States for the exhibit which the Government is to make at Paris. Professor Crosby, as one of the mineralogists to the

Commission, has collected over 400 minerals of the classes of carbonates and phosphates, making a collection which of its kind is perhaps unsurpassed by any in the country. The total cost of nearly $800 was furnished through the kindness of the Massachusetts Board of Paris Exposition Managers. Mr. Fuller, Instructor in Geology, acting as Special Agent to the United States Commission, has brought together a series of more than 300 samples of the more common and important building and ornamental stones of this country. The collection includes over a hundred polished slabs of marble, onyx, and serpentine, seventy-five dressed and polished samples of granite, and a large number of samples of representative sandstones, limestones, and slates.

At the close of the Paris Exposition these collections, with an aggregate value of more than $1,500, are to be returned to the Institute and will be incorporated with our other collections. The minerals are of unusually fine quality and will make a very important addition to the value and attractiveness of the collections of the department. The addition of the series of building stones to those we already have will make the Institute the possessor of an exceptionally valuable collection and one well adapted to giving instruction in the course in building stones.

Course XIII., Naval Architecture. — The arrangement of the work of the department has been much favored by the quarters assigned to it at the beginning of the year. A large increase in numbers has made it necessary to add to the space in the drawing-room for the third and fourth years, for which purpose a lecture-room adjoining was taken. To provide for the numbers that may be expected another year, Professor Peabody requests that the entire third floor of Engineering Building B may be cleared of partitions and made into a drawing-room for the third and fourth year classes of the department. A room with glazed walls in one corner of the proposed drawing-room can be made to provide for drawing cases, instruments, and other property of the department. At present the space is divided into three rooms,

one being used as a model-room and store-room, and the other two as drawing-rooms. It may be noted that the fourth-year class now numbers thirteen, the third-year class twenty-two, and the second-year class about twenty. Accession from other colleges is likely to give twenty or more in the third-year class next year.

Progressive speed trials were made by the department on the U. S. S. "Manning," with the consent of the Secretary of the Treasury, and under the authority of Captain C. F. Shoemaker, Chief of Division of the Revenue Cutter Service. These trials were made on June 9, 1899, over the measured mile maintained by the Bath Iron Works, at Southport, Me. The party which made these trials included Professor Peabody, Assistants Clark and Riley, and five graduates from the department. A report of the trials has been prepared for the annual meeting of the Society of Naval Architects and Marine Engineers, to occur the 16th inst.

The department has now graduated five classes, numbering thirty-five in all. Of these, three are in business, one is Instructor in Naval Architecture at the Institute, three others are Assistants or Instructors at the Institute, and twenty-eight are engaged in the practice of their profession.

SUMMER COURSES.

The attendence at summer courses this year was as follows:

I. Mechanical Drawing and Descriptive Geometry. 30. (Prof. Faunce.)
II. Mathematics: Analytic Geometry. 12. (Mr. George.)
III. Architecture. (*a*) Shades and Shadows. 3. (*b*) Elementary Design. 4. (Mr. Gardner.)
IV. Chemistry. (*a*) Analytical Chemistry. 12. (Dr. Walker.) (*b*) Organic Analysis. 2. (Dr. Mulliken.)
V. Physics. (*a*) Mechanics, Light, and Electricity. 18. (Mr. Drisko.) (*b*) Heat. 12. (Prof. Clifford.) (*c*) Physical Measurements. 9. (Dr. Goodwin.)
VI. European History. 6. (Mr. Wentworth.)
VII. Modern Languages. (*a*) French. 4. (Mr. Blachstein.) (*b*) German. 21. (Prof. Vogel.)
VIII. Mechanism. 6. (Prof. Merrill.)
IX. Shopwork. (*a*) Woodwork. 14. (Mr. Merrick.) (*b*) Forging. 12. (Mr. Lambirth.) (*c*) Chipping and Filing. 5. (Mr. Smith.) (*d*) Machine-Tool Work. 23. (Mr. Smith.) (*e*) Metal Turning. 4. (Mr. Smith.)

STATISTICS.

THE CORPS OF INSTRUCTORS.

The catalogue of this year shows the number of instructors of all grades to be 135, inclusive of those concerned with the mechanic arts, but exclusive of those who are announced as lecturers for the year only. The addition of these raises the total to 172. This year's catalogue will show an increase of seven in the number of lecturers and some changes in the grades of professors and instructors. Allusion has already been made to the augmentation of the number of the instructing staff; without counting lecturers, the number of instructors to that of students bears the proportion of one to eight and eight-tenths. This proportion is a most characteristic figure, and is intimately associated with the quality of the instruction. The following table shows the distribution among the several classes of instructors, in comparison with last year:

	1898–99	1899–1900
Professors	23	24
Associate Professors	7	9
Assistant Professors	23	21
Instructors	53	46
Assistants	28	35
Lecturers	30	37
Total	164	172

Students and Graduates.

The registration of this year, as by the catalogue now in press, amounts to 1,178. The following table shows the registration of successive years from the foundation of the Institute:

Year.	No. of Students.	Year.	No. of Students.
1865–66	72	1883–84	443
1866–67	137	1884–85	579
1867–68	167	1885–86	609
1868–69	172	1886–87	637
1869–70	206	1887–88	720
1870–71	224	1888–89	827
1871–72	261	1889–90	909
1872–73	348	1890–91	937
1873–74	276	1891–92	1,011
1874–75	248	1892–93	1,060
1875–76	255	1893–94	1,157
1876–77	215	1894–95	1,183
1877–78	194	1895–96	1,187
1878–79	188	1896–97	1,198
1879–80	203	1897–88	1,198
1880–81	253	1898–99	1,171
1881–82	302	1899–1900	1,178
1882–83	368		

Students by Classes.

The aggregate number of students for 1899–1900 is divided among the several classes as follows:

Fellows	2
Graduate students, candidates for advanced degrees	2
Regular students, Fourth Year	183
" " Third "	193
" " Second "	199
" " First "	303
Special students	296
Total	1,178

Assigning the special students to classes, according to the predominant studies pursued by them, we reach the following division of the whole body among the several years:

Class.	Regular.	Special.	Total.
Fellows	2	...	2
Graduates of the M.I.T.	2	...	2
Fourth Year	183	75	258
Third Year	193	101	294
Second Year	199	94	293
First Year	303	26	329
Total	882	296	1,178

THE COURSES OF INSTRUCTION.

The following table presents the number of the regular students in the second, third, and fourth years, by courses:

YEAR.	Civil Engineering.	Mechanical Engineering.	Mining Engineering and Metallurgy.	Architecture.	Chemistry.	Electrical Engineering.	Biology.	Physics.	General Course.	Chemical Engineering.	Sanitary Engineering.	Geology.	Naval Architecture.	Total.
4th Year Class.	38	37	25	16	18	22	2	2	2	10	4	..	8	183*
3d " "	33	36	17	17	24	27	1	3	5	11	4	1	14	193
2d " "	28	40	18	20	16	35	5	2	4	9	6	..	16	199
Total . . .	99	113	60	53	58	84	8	7	11	30	14	1	38	575*

The following table shows the figures of the total line in the foregoing table, in comparison with the corresponding figures for the next ten preceding years:

YEAR.	Civil Engineering.	Mechanical Engineering.	Mining Engineering and Metallurgy.	Architecture.	Chemistry.	Electrical Engineering.	Biology.	Physics.	General Course.	Chemical Engineering.	Sanitary Engineering.	Geology.	Naval Architecture.	Total.
1888	71	100	12	21	28	74	4	5	12	11	..	..	..	338
1889	79	99	14	30	29	91	9	5	12	14	6	..	..	388
1890	79	95	18	27	27	105	11	4	13	18	7	3	..	407
1891	81	104	17	33	23	108	11	5	19	28	9	3	..	441
1892	76	106	19	37	35	112	9	5	16	34	5	3	..	457
1893	78	97	22	50	39	141	4	10	19	31	10	2	8	511
1894	88	111	19	48	50	137	5	9	19	35	13	2	20	556*
1895	88	118	25	67	59	126	7	11	14	25	10	3	22	575
1896	99	117	24	65	66	106	7	11	11	34	8	..	25	573
1897	109	119	38	71	60	90	8	9	10	36	7	1	26	578*
1898	93	108	52	64	64	94	6	8	12	38	7	1	33	574*
1899	99	113	60	53	58	84	8	7	11	30	14	1	38	575*

* Deducting those counted twice.

The following table shows, by classes and by courses, the number of regular students who have registered themselves as electing to distribute the required studies and exercises over the period of five years:

Year.	Total.	Course.											
		I	II.	III.	IV.	V.	VI.	VII.	VIII.	IX.	X.	XI.	XII.	XIII.
1st . .	4	..	..	..	..	..	..	..	..	..	..	..	..	..
2d . .	6	1	2	2	..	..	1	..	..	..	..	..	..	..
3d . .	7	1	2	2	..	..	1	..	..	..	1	..	..	..
4th. .	14	6	1	1	..	2	2	..	..	1	1	..	..	..
5th. .	4	2	..	..	1	..	..	1	..	..	..	..	..	..
	35	10	5	5	1	2	4	1	0	1	2	0	0	0

Classification of Special Students.

Our special students can, of course, not be classified systematically; but the following table exhibits the number of such students pursuing certain leading lines of study:

Applied Mechanics . . .	95	Language	117
Architecture	42	Mathematics	142
Biology	24	Mechanical Engineering .	93
Chemistry	100	Mining Engineering . .	15
Civil Engineering . . .	46	Naval Architecture . . .	13
Drawing	125	Physics	159
Electrical Engineering .	19	Political Science	68
English	95	Sanitary Engineering . .	2
Geology	37	Shopwork	73
History	75		

The following is the number of students, either regular or special, pursuing certain leading branches of study, in each of the four years, as follows:

	First Year.	Second Year.	Third Year.	Fourth Year.	Total.
Mathematics . .	318	241	127	42	728
Chemistry . . .	350	154	95	81	680
English	315	242	26	11	594
French	144	77	53	...	274
Physics	...	284	243	162	689
German	70	202	122	...	394
Shopwork . . .	22	107	53	63	245

Residence of Students.

States.	Candidates for Advanced Degrees.	Fourth Year.	Third Year.	Second Year.	First Year.	All regular Students.	Special Students.	Total.
Alabama	..	..	..	..	..	..	..	..
California	..	3	1	1	2	7	2	9
Colorado	..	..	1	1	1	3	4	7
Connecticut	..	2	6	6	11	25	4	29
Delaware	..	..	3	..	1	4	..	4
Dist. of Columbia	..	..	1	2	2	5	2	7
Florida	..	..	..	..	1	1	..	1
Georgia	..	1	..	..	1	2	1	3
Illinois	..	8	6	9	4	27	9	36
Indiana	..	1	..	..	3	4	1	5
Iowa	..	3	1	1	..	5	1	6
Kentucky	..	1	2	..	..	3	1	4
Louisiana	..	..	1	..	..	1	..	1
Maine	..	6	..	4	8	18	7	25
Maryland	..	..	2	.	3	5	3	8
Massachusetts	4	117	124	130	189	564	167	731
Michigan	..	1	2	2	4	9	1	10
Minnesota	..	..	3	1	1	5	5	10
Missouri	..	..	1	2	2	5	6	11
Montana	..	..	..	..	2	2	1	3
Nebraska	..	1	..	..	2	3	..	3
Nevada	..	..	..	..	..	..	1	1
New Hampshire	..	7	3	2	9	21	8	29
New Jersey	..	2	1	2	1	6	6	12
New York	..	9	14	7	12	42	19	61
North Carolina	..	1	..	..	..	1	1	2
Ohio	..	4	7	2	7	20	7	27
Oregon	..	..	..	..	..	..	2	2
Pennsylvania	..	5	3	6	9	23	10	33
Rhode Island	..	2	3	4	13	22	10	32
South Carolina	..	..	..	..	1	1	..	1
South Dakota	..	..	..	..	1	1	..	1
Tennessee	..	..	..	1	2	3	1	4
Texas	..	1	..	..	1	2	..	2
Utah	..	..	1	2	2	5	1	6
Vermont	..	1	3	5	1	10	2	12
Virginia	..	1	..	..	1	2	..	2
Washington	..	2	..	1	..	3	1	4
West Virginia	..	..	..	..	..	..	1	1
Wisconsin	..	1	..	2	1	4	3	7
Foreign Countries.								
Denmark	..	..	1	..	..	1	..	1
Dutch Guiana	..	..	..	..	..	.	1	1
England	..	..	..	1	..	1	..	1
France	..	..	..	1	..	1	1	2
Germany	..	..	..	1	..	1	..	1
Jamaica	..	..	..	..	1	1	..	1
Japan	..	1	..	..	..	1	1	2
Mexico	..	1	..	1	1	3	4	7
New Brunswick	..	..	1	1	1	3	..	3
Quebec	..	..	1	..	1	2	1	3
Russia	..	..	..	..	1	1	..	1
Turkey	..	1	1	1	..	3	..	3
Total	4	183	193	199	303	882	256	1178

Thirty-eight States of the Union, besides the District of Columbia, are represented on our list of students. Of the total number of 1,178, 731 are from Massachusetts, or 62.1 per cent. of the whole; 127 are from other New England

States; 320 are from outside New England. Of these, 26 are from foreign countries.

A table showing the number of students in each year, from 1893, coming from each State or Territory, and from each foreign country, may not be without interest and instruction:

States.	1893.	1894.	1895.	1896.	1897.	1898.	1899.
Alabama	2	1	..	1	1	1	..
Arkansas	1	..	..	1	1	..	..
California	15	9	8	9	9	11	9
Colorado	5	8	7	7	8	8	7
Connecticut	30	29	27	24	30	26	29
Delaware	4	3	5	5	6	3	4
Dist. of Columbia	7	12	16	17	13	8	7
Florida	3	2	1	..	1	..	1
Georgia	3	2	2	3	4	4	3
Hawaiian Islands	2	..	..	..	..	1	..
Idaho	1	..	1	1	1	..	..
Illinois	39	36	42	45	40	51	36
Indiana	6	3	2	3	7	3	5
Iowa	13	10	12	14	12	7	6
Kansas	1	4	4	3	3	..	..
Kentucky	11	12	11	12	10	10	4
Louisiana	3	3	2	..	1	1	1
Maine	36	38	38	27	24	19	25
Maryland	4	4	9	9	8	8	8
Massachusetts	665	707	721	730	739	719	731
Michigan	7	8	7	6	5	9	10
Minnesota	11	9	5	7	8	11	10
Missouri	17	14	9	11	6	10	11
Montana	2	2	1	3	5	2	3
Nebraska	3	4	2	2	2	1	3
Nevada	2	2	..	..	..	..	1
New Hampshire	32	27	30	26	25	25	29
New Jersey	6	5	5	13	15	13	12
New Mexico	2	1	1	..	..	..	..
New York	52	59	64	69	62	68	61
North Carolina	..	..	..	1	1	2	2
Ohio	45	50	37	28	30	23	27
Oregon	1	1	1	4	3	3	2
Pennsylvania	31	37	36	42	41	34	33
Rhode Island	33	25	21	20	19	23	32
South Carolina	3	3	5	6	4	1	1
South Dakota	..	..	..	..	..	..	1
Tennessee	1	1	1	1	3	3	4
Texas	6	6	3	2	2	1	2
Utah	2	2	5	2	3	5	6
Vermont	5	3	5	7	11	12	12
Virginia	3	2	5	3	4	3	2
Washington	1	3	1	5	4	7	4
West Virginia	1	1	3	2	1	..	1
Wisconsin	11	6	7	6	6	8	7
Wyoming	..	..	..	1	..	..	..
Foreign Countries.							
Belgium	1	1	..	..	..	.	..
Brazil	..	1	1	..	..	..	..
Bulgaria	1	..	..	..	..	..	..
Cape Breton	..	..	..	..	..	1	..
Central America	1	..	1	..	..	..	..
Chile	..	1	1	1	..	..	..
Columbia	..	..	..	..	..	..	..
Cuba	1	1	3	2	1	1	..
Denmark	..	..	..	.	2	1	1
Dutch Guiana	..	..	..	..	..	1	1
England	1	..	2	2	2	4	1
France	1	..	..	1	1	1	2
Germany	2	1	..	..	..	1	1
Guatemala	..	..	..	..	.	..	..
Holland	2	2	..	..	..	..	..
Ireland	1	1	..	.	..	..	.
Jamaica	..	..	..	..	..	..	1
Japan	1	1	2	2	..	1	2
Mexico	1	1	1	3	6	7	7
New Brunswick	1	1	1	2	2	3	3
New South Wales	1	1	1	..	..	..	..
Nova Scotia	..	1	2	1	1	2	..
Ontario	4	4	2	2	..	..	..
Peru	..	..	..	..	..	..	..
Porto Rico	1	1	1	..	..	..	..
Quebec	5	2	2	2	2	1	3
Russia	..	..	..	..	..	..	1
Scotland	2	1	..	..	..	..	..
Spain	1	1	1	..	.	..	..
Trinidad	..	..	..	..	..	..	..
Turkey	..	1	3	1	3	3	3
Venezuela	1	1	1	1	.	..	..
Total	1157	1183	1187	1198	1198	1171	1178

Residence of Massachusetts Students.

It has been said that 62.1 per cent. of our students are from Massachusetts. All the counties of the State except Dukes send students to the Institute. One hundred and eleven cities and towns are on the lists. The first column of

	First Year.	Second Year.	Third Year.	Fourth Year.	Total.
Mathematics . . .	318	241	127	42	728
Chemistry . . .	350	154	95	81	680
English	315	242	26	11	594
French	144	77	53	...	274
Physics	...	284	243	162	689
German	70	202	122	...	394
Shopwork . . .	22	107	53	63	245

RESIDENCE OF STUDENTS.

STATES.	Candidates for Advanced Degrees.	Fourth Year.	Third Year.	Second Year.	First Year.	All regular Students.	Special Students.	Total.
Alabama	..	..	..	..	..	..	..	..
California	..	3	1	1	2	7	2	9
Colorado	..	..	1	1	1	3	4	7
Connecticut	..	2	6	6	11	25	4	29
Delaware	..	..	3	..	1	4	..	4
Dist. of Columbia	..	..	1	2	2	5	2	7
Florida	..	..	..	..	1	1	..	1
Georgia	..	1	..	..	1	2	1	3
Illinois	..	8	6	9	4	27	9	36
Indiana	..	1	..	..	3	4	1	5
Iowa	..	3	1	1	..	5	1	6
Kentucky	..	1	2	..	..	3	1	4
Louisiana	..	..	1	..	..	1	..	1
Maine	..	6	..	4	8	18	7	25
Maryland	..	..	2	..	3	5	3	8
Massachusetts	4	117	124	130	189	564	167	731
Michigan	..	1	2	2	4	9	1	10
Minnesota	..	..	3	1	1	5	5	10
Missouri	..	..	1	2	2	5	6	11
Montana	..	..	..	..	2	2	1	3
Nebraska	..	1	..	..	2	3	..	3
Nevada	..	..	..	..	..	..	1	1
New Hampshire	..	7	3	2	9	21	8	29
New Jersey	..	2	1	2	1	6	6	12
New York	..	9	14	7	12	42	19	61
North Carolina	..	1	..	..	..	1	1	2
Ohio	..	4	7	2	7	20	7	27
Oregon	..	..	..	..	..	..	2	2
Pennsylvania	..	5	3	6	9	23	10	33
Rhode Island	..	2	3	4	13	22	10	32
South Carolina	..	..	..	..	1	1	..	1
South Dakota	..	..	..	..	1	1	..	1
Tennessee	..	..	..	1	2	3	1	4
Texas	..	1	..	..	1	2	..	2
Utah	..	..	1	2	2	5	1	6
Vermont	..	1	3	5	1	10	2	12
Virginia	..	1	..	..	1	2	..	2
Washington	..	2	..	1	..	3	1	4
West Virginia	..	..	..	..	..	..	1	1
Wisconsin	..	1	..	2	1	4	3	7
Foreign Countries.								
Denmark	..	..	1	..	..	1	..	1
Dutch Guiana	..	..	..	..	..	.	1	1
England	..	..	..	1	..	1	..	1
France	..	..	..	1	..	1	1	2
Germany	..	..	..	1	..	1	..	1
Jamaica	..	..	..	..	1	1	..	1
Japan	..	1	..	..	..	1	1	2
Mexico	..	1	..	1	1	3	4	7
New Brunswick	..	..	1	1	1	3	..	3
Quebec	..	..	1	..	1	2	1	3
Russia	..	..	..	..	1	1	..	1
Turkey	..	1	1	1	..	3	..	3
Total	4	183	193	199	303	882	256	1178

Thirty-eight States of the Union, besides the District of Columbia, are represented on our list of students. Of the total number of 1,178, 731 are from Massachusetts, or 62.1 per cent. of the whole; 127 are from other New England

States; 320 are from outside New England. Of these, 26 are from foreign countries.

A table showing the number of students in each year, from 1893, coming from each State or Territory, and from each foreign country, may not be without interest and instruction:

States.	1893.	1894.	1895.	1896.	1897.	1898.	1899.
Alabama	2	1	..	1	1	1	..
Arkansas	1	..	..	1	1	..	..
California	15	9	8	9	9	11	9
Colorado	5	8	7	7	8	8	7
Connecticut	30	29	27	24	30	26	29
Delaware	4	3	5	5	6	3	4
Dist. of Columbia	7	12	16	17	13	8	7
Florida	3	2	1	..	1	..	1
Georgia	3	2	2	3	4	4	3
Hawaiian Islands	2	..	..	..	..	1	..
Idaho	1	..	1	1	1	..	..
Illinois	39	36	42	45	40	51	36
Indiana	6	3	2	3	7	3	5
Iowa	13	10	12	14	12	7	6
Kansas	1	4	4	3	3	..	..
Kentucky	11	12	11	12	10	10	4
Louisiana	3	3	2	..	1	1	1
Maine	36	38	38	27	24	19	25
Maryland	4	4	9	9	8	8	8
Massachusetts	665	707	721	730	739	719	731
Michigan	7	8	7	6	5	9	10
Minnesota	11	9	5	7	8	11	10
Missouri	17	14	9	11	6	10	11
Montana	2	2	1	3	5	2	3
Nebraska	3	4	2	2	2	1	3
Nevada	2	2	..	..	..	..	1
New Hampshire	32	27	30	26	25	25	29
New Jersey	6	5	5	13	15	13	12
New Mexico	2	1	1	..	..	..	..
New York	52	59	64	69	62	68	61
North Carolina	..	..	..	1	1	2	2
Ohio	45	50	37	28	30	23	27
Oregon	1	1	1	4	3	3	2
Pennsylvania	31	37	36	42	41	34	33
Rhode Island	33	25	21	20	19	23	32
South Carolina	3	3	5	6	4	1	1
South Dakota	..	..	..	..	..	..	1
Tennessee	1	1	1	1	3	3	4
Texas	6	6	3	2	2	1	2
Utah	2	2	5	2	3	5	6
Vermont	5	3	5	7	11	12	12
Virginia	3	2	5	3	4	3	2
Washington	1	3	1	5	4	7	4
West Virginia	1	1	3	2	1	..	1
Wisconsin	11	6	7	6	6	8	7
Wyoming	..	..	..	1	..	..	..
Foreign Countries.							
Belgium	1	1	..	..	..	.	..
Brazil	..	1	1	..	..	..	..
Bulgaria	1	..	..	..	..	..	..
Cape Breton	..	..	..	..	..	1	..
Central America	1	..	1	..	..	..	..
Chile	..	1	1	1	..	..	..
Columbia	..	..	..	..	..	..	..
Cuba	1	1	3	2	1	1	..
Denmark	..	..	..	.	2	1	1
Dutch Guiana	..	..	..	..	..	1	1
England	1	..	2	2	2	4	1
France	1	..	..	1	1	1	2
Germany	2	1	..	..	..	1	1
Guatemala	..	..	..	..	.	..	..
Holland	2	2	..	..	..	..	..
Ireland	1	1	..	.	..	..	.
Jamaica	..	..	..	..	..	..	1
Japan	1	1	2	2	..	1	2
Mexico	1	1	1	3	6	7	7
New Brunswick	1	1	1	2	2	3	3
New South Wales	1	1	1	..	..	..	..
Nova Scotia	..	1	2	1	1	2	..
Ontario	4	4	2	2	..	..	..
Peru	..	..	..	..	..	..	..
Porto Rico	1	1	1	..	..	..	..
Quebec	5	2	2	2	2	1	3
Russia	..	..	..	..	..	..	1
Scotland	2	1	..	..	..	..	..
Spain	1	1	1	..	.	..	..
Trinidad	..	..	..	..	..	..	..
Turkey	..	1	3	1	3	3	3
Venezuela	1	1	1	1	.	..	..
Total	1157	1183	1187	1198	1198	1171	1178

Residence of Massachusetts Students.

It has been said that 62.1 per cent. of our students are from Massachusetts. All the counties of the State except Dukes send students to the Institute. One hundred and eleven cities and towns are on the lists. The first column of

the following table shows the number of cities and towns in each county sending pupils; the second column gives the aggregate number from each county. It appears that Middlesex sends two hundred and twenty-eight and Suffolk two hundred and twenty pupils; Essex comes third, with one hundred and one; Norfolk fourth, with fifty-five.

County.	No. of Towns.	No. of Students.	County.	No. of Towns.	No. of Students.
Barnstable . . .	4	4	Middlesex . . .	30	228
Berkshire . . .	3	7	Nantucket . . .	1	1
Bristol	7	24	Norfolk	15	55
Essex	17	101	Plymouth . . .	9	33
Franklin	4	5	Suffolk	2	220
Hampden . . .	6	26	Worcester . . .	13	27
			Total	111	731

The following is a list of the towns, forty-two in number, which send four or more students to the Institute:

Boston . . .	200	Salem . . .	10	Fitchburg .	5
Cambridge .	42	New Bedford	9	Hyde Park .	5
Newton . .	39	Gloucester .	8	Middleboro .	5
Somerville .	24	Andover . .	7	Milton . .	5
Newburyport .	23	Medford . .	7	Amesbury .	4
Brookline . .	21	Melrose . .	7	Canton . .	4
Lowell . . .	21	Winchester .	7	Fall River .	4
Chelsea . .	19	Worcester .	7	Haverhill .	4
Springfield .	17	Everett . .	6	Holyoke . .	4
Brockton . .	13	Framingham	6	Pittsfield . .	4
Lawrence . .	13	Natick . .	6	Plymouth .	4
Lynn . . .	13	Peabody . .	6	Waltham .	4
Malden . .	13	Taunton . .	6	Wellesley .	4
Arlington . .	11	Concord . .	5		

The following table exhibits for ten years the distribution of the total number of students among two classes: First, those students whose names are found upon the Catalogue of the year preceding; and secondly, those whose names appear first upon the Catalogue of the year to which the statement relates:

Year.	(1) Total No. of Students.	(2) No. of Students in the Catalogue of the previous year who remain in the Institute.	(3) No. of New Students entering before issue of Catalogue.	(4) Of those in column (3) the following number are regular First-year Students.	(5) No. of New Students not of the regular First-year Class.
1890–91	937	572	365	234	131
1891–92	1,011	624	387	258	129
1892–93	1,060	618	442	303	139
1893–94	1,157	701	456	301	155
1894–95	1,183	768	415	271	144
1895–96	1,187	778	409	266	143
1896–97	1,198	758	440	263	177
1897–98	1,198	757	441	277	164
1898–99	1,171	769	402	278	124
1899–1900	1,178	764	414	275	139

Ages of Students on Entrance.

The next table exhibits the ages of our students upon entrance, after taking out three who are repeating the first year, and seventeen persons of unusual ages. These deductions

Period of Life.	1898–99.		1899–1900.	
	Half-year Groups.	Yearly Groups.	Half-year Groups.	Yearly Groups.
16 to 16½ years	2	..	2	..
16½ to 17 "	5	7	3	5
17 to 17½ "	16	..	16	..
17½ to 18 "	32	48	32	48
18 to 18½ "	45	..	57	..
18½ to 19 "	51	96	52	109
19 to 19½ "	54	..	34	..
19½ to 20 "	28	82	40	74
20 to 20½ "	16	..	28	..
20½ to 21 "	10	26	11	39
21 to 22 "	13	13	8	8
	272	271	283	283

leave two hundred and eighty-three as the number of students whose ages have been made the subject of computation.

The results appear in the table above in comparison with the corresponding results of 1898–99.

From the foregoing it appears that the average age on entrance is eighteen years and eleven months.

In this connection are presented the ages, at graduation, of the class leaving us in June. The one hundred and seventy-one members of the class were distributed among the different periods of life as follows:

Under 20½	7
Between 20½ and 21	3
" 21 " 21½	13
" 21½ " 22	9
" 22 " 23	46
" 23 " 24	44
" 24 and over	49
Total	171

The special students this year constitute twenty-six per cent. of the whole body, as against twenty-six per cent. last year and twenty-seven per cent. the year before.

Graduates of Other Colleges.

The number of students who are graduates of this and other institutions is eighty-one. Of these nine are our own graduates, three being candidates for advanced degrees.

Seventy-three are graduates of other institutions, pursuing courses of study with us either as regular or as special students. Seventeen are graduates of Harvard University; four each of Wellesley College and Yale University; three each of Amherst College and Brown University; two each of McGill, Maine, and Vermont Universities, and Dartmouth College; while the following institutions are represented on our list by a single graduate each: Acadia, Denison, DePauw, Johns Hopkins, Minnesota, Princeton, Syracuse, and Wisconsin Universities; Ashville, Beloit, Boston, Central Turkey, Christian Brothers, Colby, Davidson, Delaware, Doane, Hobart, Lafayette, Monmouth, Neuchatel, New

Hampshire, Randolph-Macon, R.I. Agricultural and Mechanic Arts, Robert, Simpson, Smith, St. John's, St. Joseph's, Southern Kentucky, Southwestern Presbyterian, Trinity, Vassar, and Villanova Colleges.

Women as Students at the Institute.

The number of women pursuing courses with us is fifty-three. Of these, five are graduates of colleges. Of the total number, five are regular students of the fourth year; five of the third year; six of the second year; six of the first year. Thirty-one are special students. Of the sixteen regular students of the upper classes, three take Course IV., Architecture; six, Course V., Chemistry; two, Course VII., Biology; four, Course VIII., Physics; one, Course IX., General Studies. Of the special students, fifteen devote themselves to Biology, eight to Chemistry, three to Architecture, two to General Studies, one to Physics, one to Naval Architecture, and one to Drawing.

Statistics of Examinations.

Of the 1,178 students of the present year, 414 were not connected with the school in 1898–99. Of these, 275 were admitted as regular students of the first year upon the basis of their entrance examinations. The 139 remaining comprise (1) those who had previously been connected with the Institute, and have resumed their places in the school; (2) those who were admitted provisionally without examination; (3) those who were admitted by examination as regular second-year or as special students; (4) those who were admitted on the presentation of diplomas or certificates from other institutions of college grade. In addition to the 275 who were thus admitted to the Institute on examination, and have taken their place in the school, 74 were admitted on examination, but have not entered the school.

In the case of the 275 persons who were admitted on examination, and have joined the school, the results of the examinations, embracing both those of June and those of September, were as follows:

Admitted clear	203
" on one condition	49
" on two conditions	18
" on more than two conditions	5
	275

Forty-seven applicants were rejected.

Examinations at Distant Points.

In addition to the entrance examinations held at Boston in July and September, examinations were conducted in July at Albany, Buffalo, Chicago, Cincinnati, Concord (N.H.), Denver, Detroit, Exeter (N.H.), Indianapolis, Kansas City (Mo.), Louisville, Manlius (N.Y.), New York, Philadelphia, Pittsburgh, Portland (Me.), Poughkeepsie, St. Louis, St. Paul, Springfield (Mass.), and Washington.

The following table exhibits the number of persons who have graduated within each of the several courses since the foundation of the school:

Year.	Civil Engineering.	Mechanical Engineering.	Mining Engineering.	Architecture.	Chemistry.	Metallurgy.	Electrical Engineering.	Natural History or Biology.	Physics.	General Course.	Chemical Engineering.	Sanitary Engineering.	Geology.	Naval Architecture.	Total.
1868	6	1	6	..	..	..	..	..	..	1	..	..	..	..	14
1869	2	2	..	..	1	..	..	..	..	..	..	..	..	..	5
1870	4	2	2	..	1	..	..	..	..	1	..	..	..	..	10
1871	8	2	5	..	2	..	..	..	..	..	..	..	..	..	17
1872	3	1	5	..	3	..	..	..	..	..	..	..	..	..	12
1873	12	2	3	1	7	..	..	..	..	1	..	..	..	..	26
1874	10	4	1	1	..	..	..	..	..	2	..	..	..	..	18
1875	10	7	6	1	1	..	..	..	1	2	..	..	..	..	28
1876	12	8	7	..	5	1	..	2	3	4	..	..	..	..	42
1877	12	6	8	4	2	..	..	..	..	..	..	..	..	..	32
1878	8	2	2	3	3	..	..	..	..	1	..	..	..	..	19
1879	6	8	3	1	3	..	..	1	1	..	..	..	..	..	23
1880	3	..	3	..	1	..	..	..	..	1	..	..	..	..	8
1881	3	5	6	3	8	..	..	1	..	2	..	..	..	..	28
1882	2	5	5	3	6	..	..	1	1	1	..	..	..	..	24
1883	3	7	5	1	3	..	..	..	..	..	..	..	..	..	19
1884	5	6	13	..	12	..	..	..	..	..	..	..	..	..	36
1885	4	7	8	2	4	..	2	..	..	1	..	..	..	..	28
1886	9	23	7	1	7	..	10	1	..	1	..	..	..	..	59
1887	10	17	8	1	9	..	8	1	1	3	..	..	..	..	58
1888	11	25	4	5	10	..	17	3	1	1	..	..	..	..	77
1889	14	24	5	3	8	..	17	1	1	2	..	..	..	..	75
1890	25	28	3	5	13	..	18	3	2	6	..	..	..	..	103
1891	18	26	4	6	11	..	23	3	3	1	7	..	1	..	103
1892	22	26	4	13	7	..	36	6	1	7	4	6	1	..	133
1893	25	30	5	2	8	..	41	2	..	6	8	..	2	..	129
1894	21	31	4	14	11	..	33	1	3	5	12	3	..	..	138
1895	25	30	3	15	14	..	33	..	2	4	11	4	..	5	144*
1896	25	34	10	24	17	..	48	3	3	7	7	4	3	5	189*
1897	25	40	7	16	20	..	33	2	3	7	12	4	1	9	179
1898	32	41	7	29	26	..	33	3	4	6	9	3	..	7	200
1899	30	38	9	22	21	..	32	2	2	1	9	1		8	172*†
Totals	405	488	168	176	244	1	384	36	32	74	79	25	8	34	2,148
Deduct names counted twice.															12
Net total.....															2,136

* Deducting names counted twice.
† Including two persons awarded degrees on the date of this report.

THE SOCIETY OF ARTS.

REPORT OF THE SECRETARY.

To the President of the Institute:

SIR: On behalf of the Executive Committee, I have the honor to present the annual report of the Society of Arts for the year May 10, 1898, to May 11, 1899.

The first meeting of the Society of Arts for the present year was held on Oct. 13, 1898. Fourteen meetings have been held, and the following papers have been read: "Bacteria in Milk; including their Rôle in Butter and Cheese Making," by Mr. S. C. Keith, Jr.; "Wool, with Practical Features that Enter into the Forming of a Wool Tariff," by Mr. Henry G. Kittredge; "Metropolitan Water Supply," by Mr. Frederic P. Stearns; "Geology of the Wachusett Reservoir," by Prof. W. O. Crosby; "Repeated Stresses," by Prof. Jerome Sondericker; "A Description of the Construction and Other Features of the South Terminal Station," by Mr. George B. Francis and Mr. Henry J. Conant; "Modern Methods of Steel Forging," by Mr. H. F. Porter; "The Diesel Motor," by Col. E. D. Meier; "The Construction of the University of Virginia, Old and New," by Mr. Theodore H. Skinner; "An American Railway in Columbia," by Mr. Francis R. Hart; "The Middlesex Fells Observatory," by Mr. George L. Hosmer; "A New Form of Induction Coil," by Mr. T. B. Kinraide; "The Present State of Metallurgy of Lead in the United States," by Prof. H. O. Hofman.

The meeting on December 22 was for the purpose of opening the new Pierce Building to the interested public.

A number of new members have been added during the year. At the close of the year 1897–98 the number of Life Members was 53. Five have died this year, leaving the present number 48.

The number of Associate Members a year ago was 323.

Of these, 1 has died and 6 have resigned, but 17 have been elected, and the present number is 333. The Life Members who have died during the year are Hon. John Cummings, Waldo O. Ross, Henry Davenport, Hon. F. W. Lincoln, and Col. Henry Lee. One Associate Member, Capt. Alfred E. Hunt, of Pittsburgh, served in the war with Spain, and brought back his regiment without the loss of a man, but has just died from the effects induced by exposure in the trying campaign.

The Board of Publication of last year was reappointed, and the "Technology Quarterly" has been conducted as before, with Dr. Bigelow as responsible editor. During the year twenty articles have been published in the "Quarterly," besides the "Proceedings of the Society of Arts" and "Review of American Chemical Research," which have appeared regularly. Of the contributed articles eight are papers that have been read before the Society of Arts, the remaining twelve having been presented by title only. Among the most notable of the latter is an extended paper by Prof. S. W. Holman, entitled "On the Telescope-Mirror-Scale Method; Adjustments and Tests."

At the last meeting of the year, the thirty-seventh annual meeting, Messrs. George W. Blodgett, Desmond FitzGerald, Edmund H. Hewins, Frank W. Hodgdon, and Charles T. Main were reëlected members of the Executive Committee, and Mr. A. T. Hopkins was reëlected Secretary for the year 1899–1900.

Respectfully submitted,

ARTHUR T. HOPKINS,
Secretary.

DEC. 12, 1899.

TREASURER'S REPORT.

STATEMENT OF THE TREASURER.

THE Treasurer submits the annual statement of the financial affairs of the Institute for the year ending Sept. 30, 1899.

Under the will of the late Edward Austin the Institute received, after payment of the United States succession tax of sixty thousand dollars, three hundred and forty thousand dollars, the income from which is to be used for special purposes designated in the will. Edward W. Hooper, Esq., most kindly and generously gave to the Institute the full sum paid by it for legal expenses incurred in connection with the settlement relating to this will and amounting to eighteen hundred dollars.

Augustus Lowell, Esq., has given fifty thousand dollars to constitute, in his own words, the nucleus of a fund, of which the income shall be used for the benefit of the Teaching Staff of the Institute in cases of illness, death, or retirement, subject to such regulations as the Government may from time to time see fit to adopt. The name attached to this gift is simply "The Teachers' Fund." The value of such an endowment is very great. The need of it has been keenly felt, and it is earnestly desired that the hope expressed by Mr. Lowell may be realized and the amount so generously devoted by him to these purposes be increased in the future by gifts from others.

In addition to the large amounts previously paid over by the executors of the will of the late Hon. Henry L. Pierce thirty thousand dollars more have been received.

Similarly the trustees of the J. W. and Belinda Randall Charity have added twenty-five thousand dollars to their previous gift, and the executors of the late Mrs. Julia B. H. James have made a further payment of six thousand dollars. From the Susan E. Dorr estate fourteen hundred and sixty-seven dollars and nineteen cents have been received, and the Ann White Dickinson Scholarship Fund has been increased by five hundred and ninety-four dollars and forty-one cents. Mrs. Wm. B. Rogers has given two hundred dollars for the purchase of periodicals, and from other friends have come gifts amounting in all to eight hundred and sixty-one dollars and thirty-four cents.

There has been an increase in the income for general purposes from stocks and bonds of more than eleven thousand dollars and also a gain in the amounts received from rents and interest, but to offset these the sum paid for salaries has increased about eight thousand dollars, and with the new building general expenses as well as the cost of fuel, water, and electricity have all become greater. In general expenses, there have been included some large items such as furniture and electrical wiring and fixtures. In connection with the transfer of certain departments to the Henry L. Pierce building extensive changes were made in the other buildings and the payments for these were charged to repair account. The result is an adverse balance of nineteen thousand eight hundred and eighty-three dollars and forty-two cents in the current expense account. There has, however, been a net gain on securities sold of nineteen thousand seven hundred and eighty-eight dollars and sixty-nine cents.

The net increase in the property of the Institute for the year is four hundred and thirty-seven thousand one hundred and fifteen dollars and twenty-six cents. It should, however, be noted that of this sum nearly three hundred and ninety-three thousand dollars are for special purposes and not available for general expenses.

Securities Sold or Paid, W. B. Rogers Memoral Fund.

$16,000	Kansas City, Cl. and Springfield R.R. 5s	1925	11,940.00
1,000	Kansas City, Mem., & Birmingham R.R. 4s.	1934	830.00
2,000	Kan. City, Mem., & Birmingham R.R. Inc. 5s.	1934	720.00
42,000	Chi., Burlington & Quincy R.R. Conv. 5s.	1903	58,601.05
1,600	Republican Valley R.R. 6s.	1919	1,600.00
255 Sh.	Detroit, Grand Rapids & Western R.R., Pf.		10,072.50
			$83,763.55

Received.

$25,000	Atchison, Topeka & Santa Fe R.R. Gen. 4s.	1995	24,470.00
7,000	Chesapeake & Ohio R.R. 5s.	1939	8,267.50
38,000	Chi., Junct. & Union Stock Yards 5s. transferred from General Funds	1915	42,022.00
			$74,759.50

Securities Sold or Paid, General Account.

$15,000	Chi., Bur. & Quincy R.R. Conv. 5s.	1903	20,928.95
3,000	Bur. & Missouri R.R. Non-exempt 6s.	1918	3,000.00
2,000	Brookline Gas Co. 5s.	1913	2,110.00
2,000	Lowell, Law. & Haverhill St. Ry. 5s.	1923	2,100.00
29,000	Walter Baker Co. Lt'd. 4½s.	1903	29,000.00
38,000	Chi. Junc., & Union Stock Yards 5s. transferred to Rogers Fund	1915	42,022.00
25,000	Illinois Steel Conv. 5s.	1910	26,250.00
55 Sh.	Chi., Bur. & Quincy R.R.		6,545.00
55 "	Chi., Rock Island & Pacific R.R.		5,885.00
½ "	Pepperell Manf. Co., New		115.50
15 "	Consolidated Gas Co., New York		2,745.00
7 "	Lowell Gas Co.		1,891.75
7 "	Lawrence Gas Co.		805.00
5 "	First National Bank, Baltimore		500.00
25 Rights	Boston Real Estate Trust		307.36
55 "	New England Tel. & Tel. Co.		151.25
			$144,356.81

Securities Bought or Received as Legacies, General Account.

25 Sh.	Boston Real Estate Trust		25,005.00
$25,000	Chi. Terminal & Transfer Co. 1st 4s.	1947	22,987.50
25,000	Illinois Steel Co. Conv. 5s.	1910	24,950.00
25,000	Illinois Steel Co. Non-conv. 5s.	1913	24,290.00
250,000	New York Revenue 3½s.	1899	250,000.00
43,000	Chesapeake & Ohio R.R. 5s.	1939	50,770.00
50,000	Chi. Junc. & Union Stock Yards Inc. 5s.	1907	50,000.00
			$448,002.50

GEORGE WIGGLESWORTH, TREASURER, *in account with*
GENERAL STATEMENT OF RECEIPTS AND DISBURSEMENTS

Dr.

Cash balance Sept. 30, 1898		110,567.63
From Augustus Lowell for Lowell Courses	6,000.00	
" " " " C. Kastner's salary	2,500.00	
" " " " School of Design	500.00	
		9,000.00
RECEIPTS FOR CURRENT EXPENSES.		
Income of funds for salaries	4,304.00	
" " " " scholarships (students' fees)	8,257.25	
" " " " Joy " [1898, 50.00]	250.00	
" " " " Swett "	400.00	
" " " " Savage "	400.00	
" " " " W. B. Rogers, 1898, etc.,	652.75	
" " " " Library	480.00	
" " " " general purposes	23,643.98	
" " Rogers Memorial Fund	10,877.63	
" " Charlotte B. Richardson Fund	1,495.15	
" " Rotch Prize Fund	400.00	
" " Rotch Architectural Fund	1,000.00	
Letter Box Fund	75.00	
Students' fees	207,118.00	
State Scholarships	4,000.00	
United States Act of 1862	5,717.56	
United States Act of 1890	8,333.34	
Gift of State of Massachusetts	25,000.00	
Biological Fund, 1898	143.50	
Laboratory supplies and breakages	9,546.57	
Rents, per Table (page 92)	16,115.81	
Gifts	2,861.34	
Interest	12,890.74	
Boston University	1,150.00	
Sale printed Lecture Notes	2,463.60	
		347,576.22
GIFTS AND BEQUESTS FOR SPECIAL PURPOSES.		
Increase James Savage Fund	126.10	
" Dalton Graduate Chem. Sch'p Fund	221.28	
" Willard B. Perkins Fund	243.20	
" Susan Upham Fund	49.84	
" James H. Mirrlees Fund	7.34	
" Letter Box Fund	18.25	
Teachers' Fund	50,000.00	
Edward Austin Fund	340,000.00	
Susan E. Dorr Fund [add'l 1,467.19]	1,718.01	
Ann White Dickinson Fund ["]	594.41	
		392,978.43
GIFTS AND BEQUESTS FOR GENERAL PURPOSES.		
Henry L. Pierce Legacy, additional	30,000.00	
James Fund, additional	6,000.00	
J. W. and Belinda Randall Fund, additional,	25,000.00	
		61,000.00
SECURITIES SOLD OR PAID. GENERAL FUND, page 83.		144,356.81
" " " Rogers Memorial Fund		83,763.55
SUNDRIES.		
Income credited to Bond Premium Acct.	2,429.00	
Income credited to Rogers Bond Premium Acct.	578.00	
Boston Art Students' Association, on acc't	666.67	
Students' Notes paid	155.00	
Students' deposits	150.00	
		3,978.67
		$1,153,221.31

MASSACHUSETTS INSTITUTE OF TECHNOLOGY.

FOR THE YEAR ENDING SEPT. 30, 1899.

Cr.

Paid for Lowell Courses	6,000.00	
" " Charles Kastner's salary	2,500.00	
" " Expense Lowell School of Design	500.00	
		9,000.00
EXPENSES.		
Salaries, per Table (page 92)	239,920.62	
" paid from Gifts	458.00	
Fellowship paid from Swett Fund	400.00	
" " " Savage "	400.00	
Prizes, Rotch Funds	400.00	
Repairs, per Table (page 93)	33,678.83	
General Expenses, per Table (page 93)	23,183.31	
Fire Insurance	2,626.35	
Biological Instrument Department	143.50	
Fuel	7,181.73	
Water	2,370.30	
Gas	2,133.70	
Electricity	1,431.08	
Printing and Advertising	3,057.67	
" Lecture Notes	1,681.38	
" Annual Catalogues and Reports	2,470.06	
Rents paid Boston & Albany R.R. Co.	180.00	
" " Natural History Society	200.00	
Laboratory Supplies and Libraries, per Table (page 92)	39,337.38	
Society of Arts	777.01	
Interest paid A. Lowell, Trustee	1,000.00	
Mech. Eng. & Applied Mechanics Department, Improvements	4,395.31	
Omaha Exposition	33.41	
		367,459.64
[Expenses more than Income, $19,883.42]		
SECURITIES BOUGHT OR RECEIVED AS LEGACIES.		
General Account (page 83)		448,002.50
Rogers Memorial Fund		74,759.50
Henry L. Pierce Building, Trinity Place, on acct.		52,992.99
Boiler and Power House, Trinity Place		22,341.74
Fire Repairs, Engineering Building and contents		16,462.63
SUNDRIES.		
Notes Receivable	100,000.00	
Funds of 1898, used	455.81	
		100,455.81
Cash balance, Sept. 30, 1899		61,746.50
		$1,153,221.31

The following account exhibits the property held by the Institute, as per Treasurer's books, Sept. 30, 1899:

INVESTMENT OF THE W. B. ROGERS MEMORIAL FUND.

$30,000.00	Burlington & Mo. River R.R. 4s. .	1910	25,787.50
27,000.00	Kansas City Belt R.R. 6s.	1916	27,000.00
6,000.00	New York & New England R.R. 6s.	1905	6,000.00
3,800.00	Republican Valley R.R. 6s. . . .	1919	3,800.00
4,000.00	Cin., Ind., St.Louis & Chicago R.R.6s.	1920	4,000.00
2,000.00	Ottawa, Oswego & Fox River R.R.8s.	1900	2,000.00
2,000.00	Kansas City, Fort Scott & Gulf R.R.7s.	1908	2,000.00
1,000.00	Lincoln & Northwestern R.R. 7s. .	1910	1,000.00
1,000.00	Atchison & Nebraska R.R. 7s. . .	1908	1,000.00
35,000.00	Fort Street Union Depot 4½s. . . .	1941	34,825.00
24,000.00	Rome, Watertown & Ogdensburg R.R. 5s.	1922	24,000.00
37,500.00	Detroit, G. Rapids & Western R.R. 4s.	1946	37,500.00
25,000.00	Atchison, Top. & S. Fe R.R. 4s . .	1995	24,470.00
7,000.00	Chesapeake & Ohio R.R. 5s . . .	1939	7,000.00
38,000.00	Chi. Junc. & Union Stock Yards 5s .	1915	38,000.00
	Advance to Bond Premium account .		10,941.84
	Bonds and Stocks		249,324.34

INVESTMENTS, GENERAL ACCOUNT.

$11,000.00	Bur. & Mo. River (Neb.) R.R. 6s., non-exempt	1918	11,000.00
2,000.00	Bur. & Mo. River (Neb.) R.R. 6s., exempt	1918	2,000.00
6,000.00	Chicago, Burlington & Quincy R.R.4s.	1922	5,100.00
3,000.00	Chicago, Mil. & St. Paul R.R. 7s .	1905	3,000.00
4,000.00	Chicago, Burlington & Northern R.R.5s.	1926	4,000.00
2,000.00	Kansas City, Fort Scott & Gulf R.R.7s.	1908	2,000.00
3,000.00	Hannibal & St. Joseph R.R. 6s. . .	1911	3,000.00
6,000.00	West End Street Ry. 5s	1902	6,000.00
35,000.00	Fitchburg R.R. 5s.	1903	35,000.00
65,000.00	Boston & Maine R.R. 4½s.	1944	65,000.00
26,000.00	Am. Dock & Improvement Co. 5s. .	1921	26,000.00
3,000.00	Illinois Central R.R. 4s.	1951	3,000.00
26,000.00	New York & New England R.R. 6s.	1905	26,000.00
8,000.00	Chi. Junc. & Union Stock Yards 5s .	1915	8,000.00
5,000.00	Dominion Coal Co. 1st. 6s. . . .	1913	5,000.00
2,000.00	New England Tel. & Tel. Co. 6s. .	1907	2,000.00
2,000.00	New York & New England R.R. 7s.,	1905	2,000.00
100,000.00	West End Street Ry. 4s	1917	100,000.00
50,000.00	Utah & Northern R.R. 1st. 7s. . .	1908	50,000.00
121,000.00	Walter Baker Co. Lt'd. 4½s . . .	1903	121,000.00
25,000.00	Chi. Terminal & Transfer Co. 1st. 4s.	1947	22,987.50
25,000.00	Illinois Steel Co., non-conv. 5s . .	1913	24,290.00
43,000.00	Chesapeake & Ohio R.R. 5s . . .	1939	43,000.00
50,000.00	Chi. Junc. & Union S. Yards inc. 5s.	1907	50,000.00
250,000.00	New York Revenue 3½s	1899	250,000.00
	Advances to Bond Premium account,		26,385.43
	Bonds		895,762.93
	Amount carried up		$1,145,087.27

Amount brought up $1,145,087.27

STOCKS.

SHARES.					
198	Boston & Albany R.R.	par	100	40,683.00	
194	Morris & Essex R.R.	"	50	14,690.00	
40	New York & Harlem R.R.	"	50	5,000.00	
85	Pittsburg, Fort Wayne & C. R.R.	"	100	12,880.00	
100	N.Y., New Haven & Hartford R.R.	"	100	17,000.00	
50	Boston & Maine R.R. common	"	100	8,300.00	
25	Boston & Providence R.R.	"	100	6,625.00	
50	Chi., Milwaukee & St. Paul R.R. Pf.	"	100	7,000.00	
50	Fitchburg R.R. Pf.	"	100	4,800.00	
90	Pullman's Palace Car Co.	"	100	10,200.00	
12	Cocheco Manufacturing Co.	"	500	6,000.00	
56	Hamilton Woollen Co.	"	100	5,390.00	
59	Everett Mills	"	100	5,310.00	
31	Great Falls Manufacturing Co.	"	100	3,472.00	
6	Manchester Mills	"	100	660.00	
2	Dwight Manufacturing Co.	"	500	1,600.00	
1	Merrimack Manufacturing Co.	"	1000	1,015.00	
17	Pepperell Manufacturing Co.	"	100	2,789.50	
10	Lowell Bleachery	"	100	975.00	
27	Essex Co.	"	50	3,780.00	
158	Pennsylvania Coal Co.	"	50	23,160.50	
40	Cambridge Gas Light Co.	"	100	7,000.00	
55	Old Boston National Bank	"	100	5,510.50	
15	Merchants' National Bank	"	100	2,220.00	
25	New England National Bank	"	100	3,875.00	
25	Atlantic National Bank	"	100	2,875.00	
10	National Union Bank	"	100	1,240.00	
25	National Bank of the Republic	"	100	3,625.00	
40	The Molsons Bank, Montreal	"	50	3,000.00	
37	Nat. Mechanics Bank, Baltimore	"	10	706.70	
5	First Nat. Bank of Baltimore	"	100	793.30	
64	Boston Real Estate Trust	"	1000	68,909.64	
1	Boston Ground Rent Trust	"	1000	900.00	
50	American Bell Telephone Co.	"	100	12,750.00	
55	New England Tel. & Tel. Co.	"	100	6,604.69	
					301,339.83

INVESTMENT OF THE JOY SCHOLARSHIP FUND.

Massachusetts Hospital Life Insurance Co. .	5,000.00	
Deposits in Savings Banks	4,123.70	
		9,123.70

INVESTMENT SWETT SCHOLARSHIP FUND.

Massachusetts Hospital Life Insurance Co.	10,000.00
Amount carried up	$1,465,550.80

Amount brought up		1,465,550.80
REAL ESTATE.		
Rogers Building	200,000.00	
Walker "	150,000.00	
Land on Garrison Street	50,840.00	
Workshops " "	30,000.00	
	80,840.00	
Land on Trinity Place	76,315.69	
Engineering Bldg. A, Trinity Place,	90,000.00	
	166,315.69	
Gymnasium Building	7,967.85	
Engineering Building B	57,857.10	
Lot No. 2, Trinity Place	137,241.60	
Henry L. Pierce Building, Trinity Place	152,875.46	
Boiler and Power House, Trinity Place	22,341.74	
Clarendon St. Land and Building	142,762.94	
House No. 34 Commonwealth Ave.	30,000.00	
Real Estate, Massachusetts Ave., Cambridge	16,154.38	
		1,164,356.76
Equipment, Engineering Building	16,555.24	
" Workshops	20,628.56	
		37,183.80
SUNDRIES.		
Notes Receivable	378,500.00	
Boston Art Students' Association	10,999.99	
Students' Notes	1,250.50	
Cash Balance, Sept. 30, 1899	61,746.50	
		452,496.99
		$3,119,588.35

The foregoing property represents the following Funds and Balances, and is answerable for the same.

The income of the following is used for the general purposes of the Institute:

William Barton Rogers Memorial Fund	250,225.00	
Richard Perkins Fund	50,000.00	
George Bucknam Dorr Fund	49,573.47	
Martha Ann Edwards "	30,000.00	
Nathaniel C. Nash "	10,000.00	
Sidney Bartlett "	10,000.00	
Robert E. Rogers "	7,680.77	
Albion K. P. Welch "	5,000.00	
Stanton Blake "	5,000.00	
McGregor "	2,500.00	
Katharine B. Lowell "	5,000.00	
Samuel E. Sawyer "	4,610.87	
John W. and Belinda Randall Fund	75,000.00	
James Fund	146,500.00	
		651,090.11
Amount carried up		$651,090.11

Amount brought up		651,090.11
The income of the following is used towards paying salaries:		
Nathaniel Thayer, for Professorship of Physics	25,000.00	
Jas. Hayward, for Professorship of Engineering	18,800.00	
William P. Mason " Geology	18,800.00	
Henry B. Rogers, for General Salaries	25,000.00	
George A. Gardner, " "	20,000.00	
		107,600.00
SCHOLARSHIP TRUSTS.		
Richard Perkins Fund	53,209.82	
James Savage Fund	13,678.55	
Susan H. Swett Fund	10,182.95	
William Barton Rogers Fund	10,615.98	
Joy Fund	9,123.70	
Elisha Thatcher Loring Fund	5,329.39	
Charles Lewis Flint Fund	5,253.93	
Thomas Sherwin Fund	5,000.00	
Farnsworth Fund	5,000.00	
James H. Mirrlees Fund	2,803.53	
William F. Huntington Fund	5,208.33	
T. Sterry Hunt Fund	3,221.46	
Elisha Atkins Fund	5,000.00	
Nichols Fund	5,000.00	
Ann White Vose Fund	60,726.82	
Ann White Dickinson Fund	40,594.41	
Dalton Grad. Chem. Fund	5,753.09	
Willard B. Perkins Fund	6,323.20	
		252,025.16
OTHER TRUSTS.		
Charlotte Billings Richardson Industrial Chemistry Fund		37,378.78
Susan Upham Fund		1,295.81
Susan E. Dorr Fund		7,138.60
William Hall Kerr Library Fund		2,000.00
Charles Lewis Flint Library Fund		5,000.00
Rotch Architectural Library Fund		5,000.00
Rotch Architectural Fund		25,000.00
Rotch Prize Fund		5,200.00
Rotch " Special " Prize Fund		5,200.00
Edward Austin Fund		340,000.00
Teachers' Fund		50,000.00
Letter-box Fund, balance		82.12
MISCELLANEOUS.		
Notes Payable	20,000.00	
Students' Deposits	300.00	
John Foster Legacy, 1898	10,000.00	
Henry L. Pierce Legacy, 1898	780,000.00	
John W. Carter Legacy, 1898	6,250.00	
M. I. T. Stock Account	809,027.77	
		1,625,577.77
		$3,119,588.35

Comparative Statement of Funds, etc.

	Sept. 30, 1898.	Sept. 30, 1899.
Trusts for general purposes	620,090.11	651,090.11
" " Salaries	107,600.00	107,600.00
" " Scholarships	251,145.14	252,025.16
" " Library	7,000.00	7,000.00
Charlotte B. Richardson Ind. Chem. Fund	37,378.78	37,378.78
Susan Upham Fund	1,245.97	1,295.81
Susan E. Dorr Fund	5,420.59	7,138.60
Rotch Architectural Library Fund	5,000.00	5,000.00
Rotch Architectural Fund	25,000.00	25,000.00
Rotch Prize Fund	5,200.00	5,200.00
Rotch "Special" Prize Fund	5,200.00	5,200.00
Moses Kimball Legacy	5,000.00	
Benj. P. Cheney "	10,000.00	
John Foster "	10,000.00	10,000.00
Henry L. Pierce "	750,000.00	780,000.00
John W. Carter "	6,250.00	6,250.00
Susan G. Coolidge Devise	14,500.00	
Edward Austin Fund		340,000.00
Teachers' Fund		50,000.00
Letter-box Fund	63.87	82.12
Biological Instrument Fund	143.50	
Students' Deposits	150.00	300.00
Notes Payable	20,000.00	120,000.00
Fire Insurance, Engineering Building	16,462.63	
M. I. T. Stock Account	779,622.50	809,027.77
	$2,682,473.09	$3,119,588.35
Increase, Consisting of:		
Bequests for Special Purposes, etc. (See page 84)	392,978.43	
Gifts and Bequests for General Purposes. (See page 84)	61,000.00	
Students' Deposits	150.00	
Net gain on Securities sold	19,788.69	
		473,917.12
Less Funds of 1898, used	455.81	
" Fire Insurance, Engineering Building, expended	16,462.63	
" Expenses more than Income	19,883.42	
		36,801.86
		$437,115.26

INCOME FROM GENERAL INVESTMENTS, AND APPLICATION THEREOF.

Applied to Salaries	4,304.00	From Dividends, Bank Stocks	1,294.90
" " Scholarships	8,257.25	" State Tax returned on Bank Stocks	238.30
" " " James Savage Fund	400.00	" Bonds	28,366.28
" " Charlotte B. Richardson Fund	1,495.15	" Dividends, Railroad Stocks	5,735.06
" " Rotch Prize Funds	400.00	" " Coal and Gas Stocks	1,622.57
" " Rotch Architectural Fund	1,000.00	" " Manufacturing Stocks	1,495.00
" " Library	480.00	" Telephone Stocks	1,078.35
" " General Purposes	23,643.98	" Real Estate Stocks	3,477.50
" " Increase of Funds	898.58		
" " Advances to Bond Premiums	2,429.00		
	$43,307.96		$43,307.96

INCOME FROM WILLIAM BARTON ROGERS MEMORIAL FUND, AND APPLICATION THEREOF.

Paid Massachusetts Institute of Technology	10,877.63	Received Income from Railroad Bonds	11,455.63
Credited to Advances Bond Premiums	578.00		
	$11,455.63		$11,455.63

DETAILS OF SOME ITEMS IN TREASURER'S CASH ACCOUNT.

Rents.

Huntington Hall, for Lowell Lectures		3,500.00	
Lowell School of Design		1,800.00	
Chauncy Hall School, for Gymnasium		100.00	
Land and Building, Clarendon St., on account		9,250.00	
34 Commonwealth Avenue, 1 year	2,200.00		
Less Annuity under Will,	1,000.00		
" Tax	390.90		
	1,390.90		
		809.10	
Use of Rooms and Gymnasium		1,165.39	
		16,624.49	
Less Tax and Repairs, Cambridge		508.68	
			16,115.81

Department Supplies.

Civil Engineering	3,972.21	
Mechanical Engineering	2,825.80	
Applied Mechanics	1,683.32	
Mining	2,553.49	
Architecture	2,576.02	
Chemistry	10,193.08	
Physics	6,714.69	
Biology	1,786.01	
English	969.91	
Modern Languages	114.83	
Geology	1,001.42	
Naval Architecture	758.06	
Drawing	109.80	
Mathematics	641.73	
Military	68.17	
Periodicals	1,937.86	
Workshops	1,430.98	
		39,337.38

Salaries.

Instruction	191,129.25	
Administration	22,422.59	
Labor	26,368.78	
		239,920.62

General Expenses.

Furniture		6,076.43	
Electrical Wiring and Fixtures		3,250.16	
Postage		2,298.48	
Legal Fees		1,892.13	
Janitors' Supplies		1,541.77	
Stationery and Office Supplies		1,266.85	
Engine Room Supplies:			
Oil	332.71		
Sundries	324.62		
Waste	69.32		
		726.65	
Entrance Examinations		611.05	
Express		601.21	
Washing		555.31	
Diplomas		433.03	
Shades		422.44	
Clocks, for Time Service		390.00	
Books, Supplies, etc., for General Library		299.96	
Sundries		295.55	
Telephone & Telegraph Co.		267.84	
Ice		266.05	
Motor, Carpenter Shop		235.00	
Lowell School of Design		212.64	
High Service Pipe		206.67	
Bicycle Shed		196.30	
Gymnasium		193.90	
Blue Books		193.59	
Locks, Students' tables, Mech. Eng.		165.97	
Removing Ashes		147.00	
Telephone Line		91.92	
Type-writing Machine		90.25	
Union Safe Deposit Vaults		75.00	
Glass		60.33	
Street Watering		48.98	
Graduation Exercises		43.85	
Western Union Telegraph Co.		27.00	
			23,183.31

Repairs.

Department Improvements:			
Civil Engineering	432.42		
Mechanical Engineering	570.55		
Mining	777.32		
Architecture	85.35		
Chemistry	2,618.93		
Physics	1,183.96		
Biology	15.91		
English	7.50		
Modern Languages	30.63		
Geology	359.57		
Naval Architecture	90.28		
Drawing	198.50		
Workshops	1,488.61		
		7,859.53	
Rogers Building		14,485.73	
Fire Escapes		2,873.26	
Walker Building		2,795.03	
Eng. Building, A and B		2,104.35	
Steam Fitting		1,127.33	
Walk to Entrance Eng. Building		1,000.00	
Roofing Vaults Walker Building		573.56	
Roofing Vaults Rogers Building		436.80	
Gymnasium		391.21	
Boiler Room		32.03	
			33,678.83

BOSTON, December 7, 1899.

An examination of the accounts of the Treasurer of the MASSACHUSETTS INSTITUTE OF TECHNOLOGY for the year ending September 30, 1899, has been made by Mr. E. A. Stone, an accountant employed by this committee. We have also verified the evidences of personal property held by the Institute.

The report of Mr. Stone is hereto annexed.

JAMES P. TOLMAN,
CHARLES C. JACKSON,
WILLIAM L. PUTNAM,
Members of the Auditing Committee.

BOSTON, December 7, 1899.

To the Auditing Committee of the
Massachusetts Institute of Technology:

GENTLEMEN: I have completed the examination of the Treasurer's accounts for the year ending September 30, 1899, and find them to be correct. I have also verified the bank balances. The trial balance corresponds with the ledger balances. The vouchers for all items paid out are accounted for. I have also examined the payments for the weekly pay-roll, and find them to be correct. The amounts charged to the students agree with the Secretary's records, and the sums received therefor are also duly accounted for.

Yours truly,
EDWIN A. STONE,
Accountant.

MASSACHUSETTS INSTITUTE OF TECHNOLOGY

ANNUAL REPORT

OF THE

PRESIDENT AND TREASURER,

DECEMBER 12, 1900.

BOSTON:
ROCKWELL AND CHURCHILL PRESS.
1900.

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PERCIVAL LOWELL.
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J. B. SEWALL.
CHARLES L. LOVERING.
A. LAWRENCE LOWELL.
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CHARLES G. WELD.
EBEN S. DRAPER.
ROBERT S. PEABODY.
ELIHU THOMSON.

On the Part of the Commonwealth.

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HON. OLIVER W. HOLMES, *Chief Justice of the Supreme Court.*
HON. FRANK A. HILL, *Secretary of the Board of Education.*

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HIRAM F. MILLS.

Committee on the Lowell School of Industrial Design.

PERCIVAL LOWELL. JOHN D. RUNKLE.
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HENRY S. PRITCHETT. A. LAWRENCE ROTCH.
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THOMAS L. LIVERMORE. JAMES P. TOLMAN.
CHARLES FAIRCHILD. CHARLES L. LOVERING.

Department of Architecture.

THORNTON K. LOTHROP. JOHN R. FREEMAN.
ELIOT C. CLARKE. A. LAWRENCE ROTCH.
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Department of Physics and Electrical Engineering.

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CHARLES W. HUBBARD. ELIHU THOMSON.

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JAMES P. MUNROE.

Department of Modern Languages.

J. B. SEWALL. NATHANIEL THAYER.
FRANK A. HILL. THORNTON K. LOTHROP.

Department of Mathematics.

PERCIVAL LOWELL. WILLIAM L. PUTNAM.
HOWARD STOCKTON. CHARLES F. CHOATE.

Departments of Chemistry and Biology.

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Department of Chemical Engineering.

ARTHUR T. LYMAN. SAMUEL CABOT.
HIRAM F. MILLS. CHARLES W. HUBBARD.

Department of Naval Architecture.

CHARLES J. PAINE. WILLIAM H. LINCOLN.
HOWARD STOCKTON. CHARLES G. WELD.

To the Members of the Corporation of the Massachusetts Institute of Technology:

GENTLEMEN: I have been with you but little more than two months, and the report which I have the honor to present at this time contains, in the nature of the case, little beyond the details furnished by the heads of the several departments. Later, with longer acquaintance, I shall ask your attention to certain recommendations regarding the work of the departments, which I feel at this time that I am not prepared to make. I wish to congratulate the Corporation on the thorough and earnest spirit of work, among both Faculty and students, which, even in so short a time as I have been here, has been evident to me.

I am glad to acknowledge, also, cordial help from my predecessor, President Crafts. It has been a source of pleasure both to the Faculty and to myself that he still remains with us as an adviser and friend, and continues to pursue his chemical researches in a private laboratory in the Walker Building.

Since your last annual meeting the Corporation has lost by death three of its members: Mr. Augustus Lowell, Mr. John E. Hudson, and Mr. Thomas Gaffield. Mr. Lowell became a member of the Corporation in 1873, Mr. Gaffield in 1896, and Mr. Hudson in 1899. In the death of these three members of the Corporation we have lost those whose counsel and whose friendship have been of great assistance to the Institute. Mr. Lowell in particular has been long identified with it. He has been since 1883 a member of the Executive Committee, and during seventeen years he has devoted his time and his thought unsparingly to the Institute, and has supported it most generously with his means. In the very short acquaintance which I had with him he im-

pressed me with his strength and breadth of character, and I felt when he died a great sense of loss. Memorials of Mr. Lowell and Mr. Hudson were presented at the last meeting of the Corporation and will be found in the "Technology Review" for January.

Walker Memorial Building.

The completion of the Henry L. Pierce Building practically exhausted the land at present available for building purposes, that on Garrison street being too remote. On the other hand, the removal of the tracks of the Boston & Providence Railroad offered an unequalled opportunity for securing additional land contiguous to our own. After prolonged negotiations, the Executive Committee, with the approval of the Corporation, secured a tract of 51,000 square feet, completing the rectangle bounded by Clarendon and Stanhope streets, Trinity place, and the passageway along the present Engineering Building "A." This purchase has direct relation to a matter which I consider of immediate importance, and to which I now call your attention.

Most of those interested in a thoughtful way in the educational institutions of the United States feel that the question of physical culture is one which as yet has been successfully dealt with in very few of our colleges and technical schools. The present attitude of most institutions of learning toward the instruction of their students in the care of health is either one of absolute neglect, or else one which fosters to an undue degree certain athletic games. In the first case the result is that most students receive no instruction as to exercise, diet, and the proper care of their bodies; while in the second case, a few students are encouraged, often at the expense of scholarship and health, to a system of severe training that is out of all proportion to normal life.

The Institute of Technology maintains a small gymnasium and provides an instructor in gymnastics for those who care to avail themselves of his services. Military instruction oc-

cupying three hours a week is given to the first-year class, and in the course of the year one lecture is given to them on the care of the body. Up to this time, however, we have not undertaken to conduct a department of physical culture, or to supervise in any way the athletic contests into which our students enter.

It is a singular thing that, while the development of modern science has been used with such success in all that pertains to the intellectual side of our development, we have been slow to avail ourselves in the same way of that knowledge which helps to prevent disease, and to conserve health. The time has come when it seems not only of vital importance, but of absolute necessity to provide a system of rational instruction in the care of the body which shall conserve the health of our students. To quote from a man who is not likely to give undue weight to the matter of physical training: "Since vigorous health and its accompanying high spirits are larger elements of happiness than any other things whatever, the teaching how to maintain them is a teaching that yields in moment to no other whatever." At present we are not giving such instruction, nor are we providing our students with a rational system of physical culture. I have, therefore, to recommend that we inaugurate at the earliest possible moment a department of physical culture.

At the head of this department should be a man familiar with student life, a trained physician, who should spend his whole time in the care and supervision of the department.

As a centre for the life of this department, we must have at an early date the Walker Memorial Building. It should be not a gymnasium in the narrow sense, but a building for physical culture and direction, in which, under the care of the head of the department, students may be introduced by the laboratory method to a knowledge of the proper laws of health. A system of physical culture could be begun which for first-year students would be compulsory. The main

features of this system would be, in addition to such lectures as the head of the department might give, the following:

(1.) Each man entering the first-year class should have a strict physical examination, and should receive in accordance therewith directions from the head of the department as to exercise, diet, and the proper method of preserving health. A careful record of these examinations and of subsequent examinations would of themselves form a most valuable series of observations.

(2.) Under the direction of the head of the department each student so examined should spend a prescribed time daily in good weather in open-air exercise. Such exercises or sports should be adapted to the need of the individual, so that, for example, the student who is inclined to be flat-chested or who is inclined to pulmonary disease may be directed to one thing, and one who suffers from an excess of fat may be sent to another. An athletic field would be a convenient but not necessary part of this system.

(3.) At times when the weather does not permit exercise out of doors, students should be required to exercise for a prescribed amount of time in a well-lighted and well-ventilated room.

(4.) Only such competitive sports should be encouraged as may secure out-door exercise, and particularly those, such as track athletics, which afford opportunity to the individual, rather than those which depend on expensive and time-consuming team work. In general, all such sports should be conducted in a way not only consistent with good scholarship, but subordinate to it.

The alumni, who began two years ago to secure subscriptions for the erection of such a building, have already obtained pledges for more than one-third of the amount desired. With a definite statement from the Corporation as to what may be available for a site for this building, together with a guarantee to furnish a man of proper qualities to direct such

a department, I feel sure that the remainder of the fund will be subscribed promptly. I have therefore to urge most strongly that the alumni of the Institute be informed that, in case the sum of one hundred thousand dollars is subscribed before July 1, 1901, the Corporation will set aside from the land recently purchased on Trinity place a site for this building, and that it will provide a director of a department of physical culture. There is no other need at this moment which in my mind is so pressing, and it seems to me absolutely necessary to dispose of this question before taking up others which will soon demand our attention. I feel that this matter is of such importance that any other recommendation which I might make to you at this time would be secondary to it.[1]

ATTENDANCE.

I have to report an attendance at the present time in the Institute of twelve hundred and seventy-seven (including four non-resident) students, the largest number which it has ever known. The increase in number has taxed the resources of some departments to the utmost, and any considerable increase above the present attendance will require additional facilities and additional space.

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[1] The following votes were passed by the Corporation at a special meeting held December 26:

Resolved, That the President is authorized to state to the Alumni that the Executive Committee will recommend that the Corporation set aside 10,000 square feet of the land on Trinity place, corner of Stanhope street, or, if preferred, 48,000 feet on Garrison street, for a site for the Walker Memorial building, on condition that $100,000 is subscribed by July 1, 1901, for the erection of the building. The Executive Committee will also provide a suitable man to conduct a department of physical culture.

Resolved, That the Faculty of the Institute be requested to confer with representatives of the Alumni and to submit to the Executive Committee a plan for the Walker Memorial building and for its use.

Changes in the Faculty and Instructing Staff.

Professor Wells has been granted a year's leave of absence after a long period of continuous service. It is hoped that he may return with much improvement in health.

Captain William Baird succeeds Lieutenant James Hamilton as Professor of Military Science and Tactics. Assistant Professors Ripley, Vogel, and Woodbridge have been appointed Associate Professors of Economics and Sociology, Modern Languages, and Heating and Ventilation respectively.

Professor Ripley graduated at the Institute in the course of Civil Engineering in 1890, and remained a year for special work in economics. He subsequently held a fellowship at Columbia University, and received the degree of Doctor of Philosophy in 1892. He was appointed Instructor in Political Economy in the same year, Assistant Professor in 1895, and has shown marked ability in his work as a teacher and an investigator.

Professor Vogel was appointed Instructor in Modern Languages in 1888, Assistant Professor in 1892, and has devoted several of his vacations to continuing his philological studies in Germany.

Professor Woodbridge was a member of the class of 1880, and Instructor and Lecturer from 1883 to 1895, when he was appointed Assistant Professor. His special studies in the direction of heating and ventilation have drawn him into professional practice on a large scale, and the Institute is fortunate now in securing a larger share of his time and attention that he has heretofore been able to give.

Mr. Homer Albers, LL.B., has been appointed Lecturer in Business Law, succeeding Mr. Joseph Willard.

Messrs. Charles W. Berry, William D. Coolidge, William T. Hall, George L. Hosmer, Joseph C. Riley, and Alpheus G. Woodman, Assistants of last year, have been promoted to the rank of Instructors.

After the close of the school year Mr. Myron L. Fuller,

Instructor in Geology, was called to the position of Assistant Geologist on the United States Geological Survey. He has been a faithful, vigorous, and successful worker, and he was appreciated for the breadth of his knowledge as well as for his interest in the welfare of the Institute.

By the resignation of Dr. William H. Walker from his position as Instructor in Analytical Chemistry, the Institute has lost the services of an earnest and efficient teacher who was achieving marked success in his work.

Leave of absence has been granted to Mr. Carl H. Clark, Instructor in Naval Architecture, for one year to enable him to obtain more extensive practical experience.

Other Instructors and Assistants of last year who have terminated their connection with the Institute to engage in professional practice or for advanced studies elsewhere are: Messrs. E. M. Bragg, W. B. Russell, and E. W. Rutherford, in Mechanical Engineering; A. A. Blanchard, L. P. Chapin, M. S. Sherrill, and L. J. Seidensticker, in Chemistry; F. H. Watts, in Civil Engineering; J. G. Coffin, in Physics; A. L. Davis, F. L. H. Kimball, and E. Walker, in Mining Engineering.

Dr. Charles Hyde Warren, of Yale University, has been appointed Instructor in Geology, in place of Mr. Fuller; Mr. Walter S. Leland, of the class of 1896, becomes Instructor in Naval Architecture, during the time of Mr. Clark's leave of absence.

The following Assistants have been appointed: R. Wilfred Balcom, John W. Brown, and James H. Walton, Jr., in Chemistry; Edward E. Bugbee, Howard C. Plummer, and William L. Stevens, in Mining Engineering; Charles M. Fosdick and Arthur B. White, in Civil Engineering; Cyrus H. Hapgood, in Physics; Walter H. James, Albert S. Merrill, Timothy C. O'Hearn, and Lawrence S. Smith, in Mechanical Engineering; Carlton Ellis, in Oil and Gas Analysis.

Teachers' Fund.

It is a source of much gratification to the Institute that the teachers' fund for aid in cases of retirement, disability, or death, has been doubled by the generous bequest of Mr. Augustus Lowell. No gift to an institution of learning is of more value than a fund for the assistance and retirement on salary of members of the instructing staff who, by reason of ill health or advancing age, are unable to continue longer in the active service of the Institute.

Degrees.

The increasing number of students entering with advanced standing or remaining a fifth year at the Institute, and at the same time the increasing demand for men trained in more than one line of engineering work, have led the Faculty to consider the regulation of candidacy for the degree in two departments at the same time. The result is embodied in the following rule:

An applicant for the degree of Bachelor of Science in two courses at the same time must have made application for such candidacy not later than November 1 next preceding his graduation. Such applications shall be granted only in the case of students who have previously anticipated fourth-year subjects in one or both of the courses in question to such an extent that they have ample time for the work proposed. All such applications shall be referred to a special committee of the Faculty to report as to the eligibility of the candidate, and, in case his application is approved, to have the oversight of all of his work for the remainder of the year, and to report to the Faculty at the close of each term as to the character of the work done. The committee shall decide as to the time and manner of carrying on the thesis work required.

A careful study of our advanced degree requirements has led the Faculty to discontinue the announcement of the

degree of Doctor of Science, and to define the requirements for the degree of Doctor of Philosophy as follows:

The degree of Doctor of Philosophy certifies to high attainments of a grade which qualifies the recipient as a scientific investigator and teacher. The course of study leading to this degree is mainly one of experiment and research, accompanied by such other theoretical subjects as may be useful adjuncts to the main scheme of work. The candidate must pursue his studies and researches under the direction and oversight of the Faculty for at least two school years, furnishing from time to time such evidences of progress as the Faculty may require. His attendance must be continuous except in cases of absence previously approved by the Faculty for the purpose of conducting researches and investigations in the field. He must present a thesis embracing the results of an extended original investigation, and must pass such final examinations as the Faculty may require. No Assistant or Instructor in the Institute, while engaged as such, shall be accepted as a candidate for the degree of Doctor of Philosophy.

SCHOLARSHIPS.

The Executive Committee assigned for the present year $5,000 from the Austin Fund for undergraduate scholarships. The number of applicants for Institute scholarships up to the present time has been 178, while 129 submitted applications for the 40 State scholarships. Ninety-one of these made applications in both places, leaving the total number of applicants considered by the Faculty and the State Board of Education 216. Of these, 28 have received scholarships to the amount of full tuition, 129 others have received smaller amounts, averaging somewhat more than $100 each. In accordance with the Act of the Legislature authorizing division of State scholarships, 26 of the 40 were so divided, thus increasing the number of recipients to 66.

On recommendation of a special committee appointed by

the Faculty, the following votes have been passed in relation to the income of the Austin Fund:

(1.) That teachers who are known to be thoroughly prepared for undertaking graduate work be accepted as candidates for scholarship aid on the same terms with graduate students, and that their applications be presented to the Standing Committee on Advanced Degrees and Fellowships. Such applicants will, in general, be college graduates.

(2.) That, in general, teachers applying for scholarship aid be not required to conform to the regular courses if they have presented definite, well-considered plans of study approved by the Faculty. It is understood that such applicants will be expected to have done good work at the Institute for a year, and to present such evidence of their need of aid as the Committee on Scholarships may require. It is expected that their applications will be made through the heads of the respective departments.

(3.) That aid be allowed towards meeting the cost of the Institute Summer Courses or Summer Schools in exceptional cases on application by the head of the department to the President.

Graduate Scholarships.

The graduate scholars of the current year are Messrs. Elbert G. Allen, S.B., Stephen F. Gardner, S.B., and Isaac Osgood, S.B., all of the class of 1900, and Frederic A. Watkins, S.B., of the class of 1899; Eric H. Green, A.B., A.M., of Brown University; Carlton R. Rose, Ph.M., of the University of Michigan. Messrs. Allen, Gardner, and Osgood are candidates for the Master's degree. Messrs. Green, Rose, and Watkins are special students in Chemistry, Mining Engineering, and Electrical Engineering, respectively.

Fellowships.

Mr. Gorham P. Stevens, of the class of 1898, retains the Swett fellowship, and is continuing his studies at the Atelier

Pascal in Paris. His admission to the École des Beaux-Arts as twenty-third out of sixty candidates shows the high quality of his work.

The Savage fellowship has been awarded to Mr. Paul L. Price of the class of 1900, who is continuing his architectural studies at the Institute.

Besides these fellowships of long standing, the income from the Austin fund has enabled us to make the following additional appointments:

Mr. Arthur A. Blanchard, of the class of 1898, and for the past two years Assistant in Theoretical Chemistry, Mr. Louis P. Chapin, a graduate of the University of Minnesota and since 1897 Assistant in General Chemistry, and Mr. Miles S. Sherrill, of the class of 1899, Assistant in Analytical Chemistry, are taking courses at the University of Leipzig. Mr. Joseph G. Coffin, of the class of 1898, for the past two years Assistant in Physics, is a graduate student at Clark University. Mr. George B. Ford, of the class of 1900, is taking advanced work in Architecture at the Institute.

The following reports are made on the fellows of last year:

Mr. George K. Burgess, of the class of 1896, has held the Savage fellowship for the last two years. He has taken a course of study in the University of Paris under the immediate charge of Professor Lippmann. His subject of investigation has been a new mode of determining the gravitation constant. The apparatus, a description of which was published in the "Comptes Rendus" of Aug. 21, 1899, was of such extreme sensitiveness — surpassing in this respect any previous device — that his investigations were subject to considerable delay. Mr. Burgess expects to take his final examinations next summer. At present he has an appointment as Instructor in Physics at the University of Michigan.

Mr. H. W. Gardner, Instructor in Architecture, was absent in Europe for a year on a grant from the Austin Fund. The greater part of his time was spent in Italy in making careful measured drawings of certain monuments that had special

bearing on his future work at the Institute. In particular he studied the landscape gardening of a number of famous villas. At Lante, near Viterbo, he was allowed full scope to measure and draw as he pleased. He has made a complete drawing of the famous gardens of this villa. Mr. Gardner's own report will soon be ready, when an exhibition of the work that he has done will be given.

Advisers.

During the year the system of advisers has had some additional development. This system was introduced seven years ago, and, while data as to the results are necessarily meagre, it is believed to have worked reasonably well. Heretofore the new students of each year — about four hundred and fifty — have been distributed somewhat uniformly among the entire instructing staff. Last spring the Faculty adopted the plan of appointing a definite committee of student advisers, numbering about thirty members, selected with special reference to the service desired. The number of students assigned to each adviser is proportionately increased, but it is not likely to prove burdensome. During the first weeks of students' connection with the Institute, when many of them are meeting unaccustomed responsibilities, and when mistakes may have far-reaching consequences, it is of great importance — difficult though the task is — for us to secure adequate acquaintance with them.

"Technology Review."

The publication of the "Technology Review" has been continued by an editorial committee representing the Association of class secretaries, and the great success of the "Review" in every respect reflects the highest credit on its management. In spite of a discouraging deficit at the end of the first year, the committee has, without any sacrifice of the high standard set by the early numbers, made such improve-

ments and retrenchments as to make the publication nearly self-supporting. It is to be hoped that the subscription list of the "Review" will be so maintained and increased by all who are interested in the Institute as to relieve the editorial board of a burdensome part of their present loyal service.

Paris Exposition.

As stated in the last report, the Institute was requested by the officials of the United States Commission for the Paris Exposition to be one of two institutions for exhibiting higher education in engineering and architecture in the United States. The Executive Committee authorized the necessary expenditure, and a committee of the Faculty carried out the preparation of the exhibit.

The amount of space allotted to the Institute was at first so limited that an effective exhibit was deemed out of the question; but by the courtesy of Director Rogers a special assignment of hanging space on an important façade was made which permitted an effective display of large architectural designs. The remainder of the exhibit consisted chiefly of photographs of a standard size mounted in wing-frames, and of portfolios with text and photographs illustrating the work of our engineering departments. Liberal use was made of the various Institute publications, and effective aid was rendered by Institute graduates connected with the Massachusetts Commission or resident in Paris. Besides this main exhibit special collections of minerals and other building stones were made through our department of geology. The material for these was collected from all parts of the country by Professor Crosby and Mr. Fuller, and at the close of the Exposition came into the possession of the Institute. The work of the department of economics in the preparation of the exhibit of the Massachusetts State Board of Health is referred to on page 28. All the members of the Faculty who visited the Exposition during the summer brought back most gratifying reports of the success of our exhibit.

The awards made by the Exposition authorities included the *grand prix* for the Institute in the class of Special Industrial and Commercial Education, gold medals in the classes of Higher Education, Special Education in Fine Arts, and Working of Mines, Ore Beds, and Stone Quarries. A gold medal for the exhibit of the Student Coöperative Society was also awarded. Within a few days we have been much gratified to receive a request on behalf of the French government for the presentation of a number of the large architectural designs to the École des Beaux-Arts.

Eclipse Expedition.

Last May the Institute sent a party under the charge of Professor Burton to Washington, Ga., to observe the total eclipse of the sun. While the Civil Engineering Department is not fully equipped to carry on all kinds of astronomical work, such work being not essential for the instruction of the civil engineer, it was felt that the opportunity should not be lost. The party consisted of Professor Burton, Professor Robbins, and Mr. Hosmer, of the Civil Engineering Department; Professor Bartlett, of the Mathematical Department; Mr. H. W. Smith, of the Physical Department; and Mr. Walter Humphreys. The work of the civil engineering staff consisted in the precise determination of the times of contact. A full account of the expedition has been published by Professor Burton in the "Technology Quarterly" and in the "Technology Review."

The Departments.

Courses I. and XI., Civil and Sanitary Engineering. — For the sake of uniformity, a slight change has been made in the arrangement of the studies in the Civil Engineering Department. The force of instruction remains as before, except that Mr. F. H. Watts has resigned his position as Assistant to accept a position on a railroad in the West, and that, on account of the large number of students taking courses in

surveying and topographical drawing, two additional Assistants have been required. The number of students in the second-year drawing room is 107, of which number, 41 are taking the course in Mining Engineering, and 4 the course in Landscape Architecture.

The demand for graduates in Civil Engineering has been larger this year than ever before. Since last May applications have been received for not less than 69 men, excluding a number of applications for men to take temporary positions during the summer. One of the recent graduates of the department is engaged in the construction of water-works in Corea, and another in engineering work in Havana.

The thirteenth session of the Summer School of Civil Engineering was held at Sunapee, N.H., in June last, and was attended by ten students. The work was in direct charge of Instructors K. S. Sweet and G. L. Hosmer, assisted by Messrs. Russell, Thurber, and Delano of the class of 1900. Professor Barton also attended the school for a short time and made several geological trips with the students. The work was of the same character as that usually performed, consisting of base-line measurement, triangulation, plane table and other topographical work, together with hydraulic measurements in rating meters and gauging the flow of streams and practice in taking soundings.

Course II., Mechanical Engineering. — The new option in Heating and Ventilation in the Mechanical Engineering course has now been in effect for one year. In this option, besides the work in heating and ventilation, the students attend a short course in the Biological Department upon sanitary hygiene, and a course in the Physical Department upon electric motors. The course in Heating and Ventilation is given by Associate Professor Woodbridge, assisted by Mr. Charles F. Park, Instructor in Mechanical Engineering. Six students of the class of 1901 and one graduate have selected this option.

The department has also been called upon to provide for

a considerable additional amount of work in connection with a new option in the course in Chemistry and with another in the course in Physics. In both cases courses in mechanism and drawing are given, as well as other work in mechanical engineering.

Course III., Mining Engineering and Metallurgy. — The large increase in the number of students taking this course led, two years ago, to the installing of a number of small individual plants for concentrating, and one year ago to the division of the class into three sections which receive laboratory instruction in rotation from Professors Richards, Hofman, and Lodge. These changes have now been subjected to a year's trial and have enabled the department not only to handle the increased number of students, but to do so with improved results. By a redistribution of work, all the lectures in mining are given by Professor Richards, and all those in metallurgy by Professor Hofman. On page 23 reference is made to work done in metallography by students in this department, under supervision of the department of Chemistry.

The laboratory is constantly made more efficient by the introduction of new machines and by improved adjustments and appliances adapted to the old machines. By the installation of ten little amalgamation pans, ten students can in a single afternoon try a series of tests. When the results are tabulated, the best mean result is at once apparent, and the evils of excess and deficit are easily pointed out. Several new hydraulic classifiers as well as a small riffle-table have been installed.

The appointment of an assistant for library and museum work is making both these collections of greater value to the students.

The Summer School of Mining was held last June in New Jersey and Eastern Pennsylvania. From Dover visits were made to the Richard mine, where the rich and extensive ore bed and the fine new compressing plant were studied; and

to the Andover and Joseph Wharton Mines of Hibernia, where the students were much interested in studying the Ball-Norton magnetic concentrating plant. A visit was also made to Edison's great magnetic separating plant with all its ingenious labor and power saving devices. The next visit was to Pottsville, Pa., for a geological view of the coal measures. Here the Mahanoy City Colliery and breaker were made special subjects of study. In the valley of the Lehigh visits were made to the mine of brown-iron ore at Ironton, the cement mines and works at Copake. The iron blast furnace at Hokendauqua, the zinc furnaces of the New Jersey Zinc Company, South Bethlehem, and the open hearth furnaces, forging presses, and great gun shops of the Bethlehem Steel Company, were also visited.

Course IV., Architecture. — In the option in Landscape Architecture, now in the second year of its existence, there are ten students, five in the second and five in the third year. As yet there appears to be no reason for a change in the course of instruction. We have daily proofs of the unrivalled advantages that we can offer for this study in our close proximity to the Arnold Arboretum, where much of our regular work is done, and to Brookline and other suburbs where many fine estates have been thrown open to our students through the courtesy of their owners.

The option in Architectural Engineering graduated its first class last year, and it is a pleasure to report that good positions were found for all its members. The importance of this field is fully acknowledged, and the number of pupils now pursuing the course proves its attractiveness. Our graduates are more and more realizing the need of a year's uninterrupted study in some one field, and return to take advantage of the opportunities offered by the department for advanced work.

The Rotch prizes, given annually to students in the department, were this year awarded to Mr. G. B. Ford and Mr. J. L. Little, Jr. Both students are taking graduate work.

Mr. Ford and Mr. P. L. Price, a graduate from the option in Architectural Engineering, are candidates for the Master's degree. The Boston Society of Architects has awarded prizes in books of the value of fifty dollars each to Mr. C. H. Stratton and Mr. W. R. Kattelle, both of the class of 1900.

The drawings sent to the Paris Exposition were selected to present a characteristic exhibit of the work done in an American school of architecture. The honor with which they have been distinguished by the French government has been referred to elsewhere. The drawings of Professor Despradelle's "Beacon of Progress," a full description of which was published in the "Technology Review" for October, 1900, have been accorded equal distinction.

The work of the students in the summer school of Architecture has again been the study of the old colonial buildings. The interior of King's Chapel was first measured, and here was given the necessary drill in the systematic plotting of lines and measurements, the use of lead strips in getting the forms of mouldings, etc. The work done here proved that many errors had been allowed in the published drawings of the building. From Boston Professor Homer took his class to Providence, where through the courtesy of the Rhode Island School of Design they obtained an excellent room for day and evening work. After ten days spent in making a great number of measured sketches, the class returned to the Institute, and devoted the remaining days to putting the material in hand into accurately made drawings.

Courses V. and X., Chemistry and Chemical Engineering. — The course in Chemistry has undergone material modification during the past year. The attention of members of the department has been for some time past called to the need that graduates of this course have felt for some knowledge of the principles of mechanical engineering. Many of them whose work is in technical or manufacturing chemistry are so situated as to be called upon to superintend the care of machinery or mechanical operations. To meet these needs

a series of optional studies has been arranged, with the advice and coöperation of the Department of Mechanical Engineering. While the course was being thus revised, it was thought also worth while to arrange other series of optional studies, extending through the four years, which would, without sacrificing general training, admit of a certain amount of specialization along lines in which there is a demand for graduates from this department. Option 1 is essentially a course in Chemistry with elementary courses in mechanism and valve gears (with drawings), and a course in engines and machines. Option 2 includes almost all the laboratory courses, general and special, and affords training for those who wish to pursue purely chemical lines of technical work. Option 3 affords a preparation for work in municipal or so-called sanitary chemistry. Option 4 specializes along metallurgical lines, in the fourth year of the course. Option 5 presents a course in pure chemistry, which, like the course in pure physics, is intended to prepare students to become teachers, especially in higher institutions, or to undertake research work.

The equipment of the department has been increased by the fitting up of a research laboratory for Professor Crafts.

The number of students taking analytical chemistry is 135. Of these 80 are taking qualitative analysis and 53 are taking quantitative analysis. Of the latter, three are graduate students from other colleges and two are teachers. The class-room instruction in theoretical chemistry has been materially improved by the working out of a systematic series of experiments which are now shown in connection with the lectures. Investigations in metallography have been continued during the past year by students of the fourth year electing this subject for thesis work. Although the microscopic outfit is in excellent condition for research work, yet, if the present demand for theses in this subject should continue, the laboratory facilities for heat measurements must be greatly increased.

The need of a room to be used as a chemical museum is pressing. At present the department can hardly encourage the presentation of chemicals or models of apparatus, as it lacks a suitable place for exhibition or even for storage.

The summer course in organic chemistry was unusually well attended. Of the thirteen students enrolled, seven were regular students of the Chemical course. Compared with the total number of students in the course, this number is small, probably on account of the expense. It is, nevertheless, to be regretted that so few of the better students of the class avail themselves of this opportunity to anticipate a large part of their fourth-year work, and thus to gain much-needed additional time for their theses.

Courses VI. and VIII., Electrical Engineering and Physics. — In the course of lectures on general physics, which is given to all regular students of the second year, very considerable modifications have been made during the past few years, in order to present better the recent advances in this science. The rapid enlargement of the whole subject and the fact that the character of these advances is rarely such as to render the older knowledge less important will soon necessitate an extension of the time allotted to it.

A noteworthy addition to the instruction in the course in Electrical Engineering which goes into effect during the present term is a brief series of lectures by Professor Clifford upon the mathematical theory of the propagation of electric waves, a subject which has assumed great practical importance during the past year. This course has been made alternative with that upon railroad signals.

An addition to the work in Electrical Engineering is caused by the establishment of a new option in Heating and Ventilation in the course in Mechanical Engineering, the students in which receive additional instruction in the application of electricity to mechanical purposes. The work has been undertaken by Professor Puffer, and the course on dynamo-electric measurements given to students of the

course in Mechanical Engineering, and the course in Mining Engineering and Metallurgy has been transferred to Mr. W. L. Smith, Instructor in Electrical Engineering.

In the course in Physics an option has been established in Electro-Chemistry. It will include, first, an extended series of exact measurements on electrolytic conduction, transference, polarization, electrolysis, etc.; second, advanced work, including electro-deposition of metals, the electrolytic separation of metals, conductivity of fused electrolytes, electrolysis at very high temperatures, and reductions in the electric-arc furnaces. The option will also include complete efficiency tests of accumulators and of various electrolytic cells. For this work considerable additional equipment will be necessary, and the laboratory will have to be furnished with currents of several hundred amperes for running the electric furnaces. Already the importance of such work has been recognized in several of the polytechnic schools in Germany; but, so far as is known, a laboratory thus equipped for electro-chemical work is unique in this country.

The laboratory of heat measurements has been much hampered by the unexpected increase in the size of the classes, for which both room and teaching force are inadequate. There is an increasing demand for instruction in the accurate measurement of high temperatures and calorific powers. The latest call is for work in connection with the electrical furnace. In view of these demands, the most pressing problems in the branch of physics to which this laboratory is devoted are the study of the methods for maintaining and measuring very high temperatures, and the treatment of the problems in heat which bear upon the development of the modern cold storage systems and methods.

Professor Bartlett, who for the past nine years has done the greater part of the arduous work of examining the laboratory note-books of students in General Physics, has been relieved, and the work has been given to Mr. M. de K. Thompson, Assistant in Physics. Every one knows that the efficiency of

laboratory instruction depends to great extent upon the faithfulness with which this work is done, and that there are few duties which are more tedious. The laboratory owes a great deal to Professor Bartlett's long and painstaking service.

The laboratory of acoustics is so noisy and is so largely devoted to office purposes that its work is rendered very difficult. The optical laboratory is without a suitable room. Indeed, the disadvantages under which the department labors from want of room, and which have been referred to in the President's reports for a number of years, grow more and more serious.

Course VII., Biology. — Important changes have been made in the programme of studies in this department (and to some extent in the biological subjects in the courses in chemistry and sanitary engineering) by which more time is given to bacteriology and industrial biology, more time is reserved for thesis work in the final term, and a new subject is introduced. These changes have been made necessary by the rapid growth of bacteriology and its applications to engineering and the arts.

A new course in municipal sanitation is an outgrowth of that in sanitary biology. It includes the study of the sanitary aspects of pavements and dust-nuisances; of street cleaning; of the utilization or disposal of garbage and refuse (ashes, dirt, paper, and other combustible wastes); of the smoke-nuisance; of public parks and playgrounds; of public supplies, such as water, gas, milk, and meat; and of public buildings or institutions, such as theatres, libraries, latrines, markets, baths, gymnasia, prisons, almshouses, etc.

A brief course in the hygiene of heating and ventilation, given by Professor Sedgwick, has been introduced this year in connection with the new option in the department of Mechanical Engineering.

Assistant Professor Hough has continued and extended his important researches on the physiology of muscular work and fatigue, by new and fruitful experiments with the ergo-

graph, and an account of his latest work is just issuing from the press. In the spring he published in the "American Physical Education Review" a valuable paper on the "Flow of Lymph and its Relation to Muscular Exercise," and also as a separate monograph an extended and critical review of the theory and practice of the Swedish system of gymnastics, which has excited much favorable comment, and has recently been incorporated as a special monograph in the Annual Report of the United States Commissioner of Education.

The bacteriological laboratory is so inadequate to the needs of the classes as to constitute a serious drawback to effective work. If the recommendations made last year in the President's report cannot be adopted, temporary relief, at least, should be given by the assignment of more space in the Henry L. Pierce Building.

Course IX., General Studies: Economics, History, English. — A special effort has been made during the past year to furnish the students in the third-year class in political economy, which consists of nearly all regular third-year students, with a larger amount of printed matter. The syllabus distributed weekly is now four pages instead of one. The work is also being concentrated upon a smaller number of topics, each of which is of genuine interest to the engineer and the man engaged in practical business. In the development of this plan, and with a view of enlisting on the part of the student a more personal interest, it is proposed to offer options during the second term, permitting the student to select from courses on banking and exchange, finance, railroad economics, the relation of laborers and employers, methods of wage payments, merchant marine, etc.

For the more special work of the General Course, a large number of diagrams have been mounted and the collection of graphic material has been enlarged. The student is also engaged in the plotting of diagrams from day to day and week to week on current financial or commercial phenomena, which are published in the reports of the United States

Treasury Department, or by boards of trade and banking organizations. For example, graphic records have been made of the available cash balance in the United States Treasury, receipts and expenditures of the government, the rate of foreign exchange, the weekly clearing house returns, both of New York and Boston, the exports of wheat and flour, the exports and imports of specie, the movement of money to and from the interior as kept by New York banks.

During the past summer one of the students in the class in anthropology collected data relating to the social and physical characteristics of negroes on a Louisiana plantation. Over three hundred persons were examined and the data tabulated on cards. The material thus obtained will be used for a thesis.

At the request of the Board of Paris Exposition Managers of Massachusetts, and also of the United States Commission of the Paris Exposition, a large number of diagrams were prepared under the supervision of Professor Dewey. A considerable part of this work was done by students of the Institute, and this series of charts, as a rule, received the highest approval of the Exposition Jurors.

Professor Dewey's work on the Financial History of the United States will soon be published in the American Citizen Series, edited by Professor Hart of Harvard University.

A new course on recent history and political conditions in Eastern Asia was given for the first time in the spring term of 1900. Beginning with a general geographical and historical survey, the class studied, from standard authorities, official publications, and current literature, various phases of the Eastern question, — more particularly the expansion of Russia and Russian interests on the Pacific, — recent events in China looking towards railway and industrial development of the country, together with the probable establishment there of spheres of European control, and the commercial and political interests of the United States in these and other

trans-Pacific changes. The class was regularly open, as an option, only to the members of the fourth-year class in the course of General Studies. Hereafter it may perhaps be offered with advantage to students in other courses.

The fact that more attention has of late years been paid to English in the best secondary schools makes in every class a more marked difference between students trained in these schools and those less fortunate. This difficulty is now met by dividing sections according to grade as early in the term as this can be done intelligently and the proficiency of the students judged by actual work. This wide difference in proficiency at entrance makes of highest value the system of assigning special work in English to any student, no matter what his standing otherwise, who shows marked weakness in composition. The system of examination of first-year note-books in chemistry is now arranged on a basis which brings it more closely in touch with the regular work in composition; and all along the line the effort is being made to insure that the written work which students do in their scientific study and outside of formal classes in composition shall not encourage bad literary habits or undo the good of the course in rhetoric. The courses in advanced composition and in literature, given primarily for students in the course in General Studies, are still attended as electives by students from other departments, and in this way English is brought constantly more closely in touch with the strictly technical side of Institute work.

Course XII., Geology. — The total membership of the different classes taught in the department during the year was 439.

Professor Crosby has spent about three months among the mines of southwestern Missouri, and he has brought to the Institute a very full and representative collection of the zinc and lead ores and their associated minerals. Probably there is no other collection of the minerals of that region which surpasses this one in completeness and educational value.

Course XIII., Naval Architecture. — The department of Naval Architecture has arranged for a short course of lectures on Ordnance and Armor to be given by Professor Philip R. Alger, U. S. N., of the Naval Academy at Annapolis, in February or March.

The drawing room for students of the third and fourth years in the department is now arranged for fifty tables, and the room is lighted by a very satisfactory method proposed by Professor Puffer, and installed under his supervision.

Mathematics. — No marked changes have occurred in the work of the Department of Mathematics during the past year. The absence of Professor Wells for the present school year has been elsewhere referred to. It has not been found necessary to make an additional appointment in his place, as members of the staff have been able to take additional work to the extent necessary. It was noted in the last President's Report that the number of sections in calculus had been increased from twelve to fourteen. This year the considerable increase in the size of the entering class has required an increase from sixteen to eighteen sections in algebra. Moreover, the average size of first and second year sections is such as to make a further increase in their number desirable in the near future.

The Runkle Library of Mathematics is proving very helpful to instructors and students, and as time passes is more and more used.

Modern Languages. — The efficiency of the Department of Modern Languages has been increased by frequent departmental meetings, by dividing systematically and carefully, between the two terms, the work allotted to every class, and by a greater uniformity of purpose and method in the instruction of all classes and sections.

On account of the increasing demand for instruction in Spanish, there has been for three years no instruction in Italian, which used to alternate with Spanish. In view of this fact Professor Rambeau recommends that there shall be

two options in Spanish every year, an elementary course and a higher one, and that optional instruction in the elements of Italian be also given every year. Moreover, it seems desirable that the Institute should offer to the students of all departments optional advanced courses, not only in French and German, but also in Spanish and Italian.

Shopwork. — Professor Schwamb reports that the total registration at the workshops this year is 373; the total number of students, 272, — a marked increase over any previous year. In spite of the fact that a considerable number of students anticipate shopwork in our summer courses, the space available in the machine shop is now taxed to its utmost capacity, and several special students have necessarily been refused admission. A small instruction room for use in connection with the machine shop has proved of much value, and a similar arrangement is recommended for the wood-working and forging.

Summer Courses.

The attendance at summer courses this year was as follows:

Mechanical Drawing and Descriptive Geometry. 43. (Prof. Faunce.)
Mathematics: Analytic Geometry. 16. (Mr. Carter.)
Architecture. (*a*) Shades and Shadows. 3. (*b*) Elementary Design. 5. (Mr. Skinner.)
Chemistry. (*a*) General Chemistry. 38. (Mr. Phelan.) (*b*) Analytical Chemistry. 1. (Dr. Walker.) (*c*) Organic Analysis. 7. (Dr. Mulliken.) Organic Chemistry. 3. (Dr. Mulliken.)
Physics. (*a*) Mechanics, Light, and Electricity. 20. (Dr. Wendell.) (*b*) Heat. 19. (Prof. Clifford.) (*c*) Physical Laboratory. 14. (Dr. Goodwin.)
Modern Languages. (*a*) French. 7. (Mr. Dike.) (*b*) German. 14. (Dr. Dippold.)
Mechanism. 9. (Prof. Merrill.) Mechanical Engineering Drawing. 19. (Mr. Park.)
Shopwork. (*a*) Woodwork. 5. (Mr. Merrick.) (*b*) Forging. 13. (Mr. Lambirth.) (*c*) Chipping and Filing. 9. (Mr. Smith.) (*d*) Machine-Tool Work. 24. (Mr. Smith.)

THE LIBRARIES.

The total number of additions to the libraries during the year 1899–1900 was 4,520. After deducting books purchased to replace volumes that have been worn out or lost, books counted twice, etc., the total net increase in the size of the library amounts to 3,702 volumes, 497 pamphlets, and 66 maps. The distribution of this increase among the departmental libraries is shown in the following table:

Table of the Net Accessions for the Year 1899–1900, with the Cost of the Same, and the Total Contents of the Libraries of the Institute, Sept. 30, 1900.

LIBRARIES.	Net Increase.				Total Contents.	
	Volumes.	Pamphlets.	Maps.	Cost.	Volumes.	Pamphlets and Maps.
General Library: General	320	158	..	$122 41[1]	4,574	3,724
General Library: English	136	...	..	173 71	2,671	38
General Library: Modern Languages	192	...	5	276 60	834	23
General Library: Military Science	8	1	..	4 69	150	7
Totals	656	159	5	$577 41	8,229	3,792
Architecture	191	...	..	438 15	2,639	210
Biology	186	14	..	279 37	2,371	433
Chemistry	388	51	..	599 47	7,944	1,597
Engineering	670	142	60	1,121 00	9,492	3,783
Geology	143	5	..	170 83	2,074	827
History and Economics	653	60	..	519 91	10,157	3,225
Mathematics	129	2	..	230 69	1,035[2]	176
Mining	264	21	1	394 24	2,589	429
Physics	422	43	..	647 46	6,705	750
Margaret Cheney Room	...	...	..	.....	616	13
Totals	3,702	497	66	$4,978 53	53,851	15,235

[1] Including books placed in the Secretary's office.
[2] Exclusive of the Runkle Library.

The total number of serial publications of all kinds that we receive regularly now amounts to 871. The distribution of the periodicals and other serial publications among the de-

partmental libraries, and their cost, are shown by the following table:

Table of Periodicals and other Serial Publications received during the Year 1899–1900.

Libraries.	Number Received.					Estimated Cost.			
	Gifts.	Paid by Dept.	Periodical Account.		Totals.	Paid by Department.	Periodical Account.		Totals.
			Exch.	Subs.			Exch.	Subs.	
General	31	3	20	35	89	$23 50	$48 00	$123 88	$195 38
Architecture	1	3	4	32	40	6 28	9 60	191 17	207 05
Biology	20	6	8	38	72	21 10	19 20	223 90	264 20
Geology	15	1	8	5	29	2 50	19 20	20 95	42 65
Chemistry	78	15	15	43	151	48 16	36 00	217 99	302 15
Engineering	39	33	68	53	193	71 75	163 20	219 91	454 86
History and Economics	40	30	6	62	138	59 26	14 40	210 34	284 00
Mathematics	....	...	2	15	17	.....	4 80	56 31	61 11
Mining	18	1	21	25	65	179 00	50 40	85 60	137 79
Physics	9	5	31	29	74	17 41	74 40	144 95	236 76
Lowell School of Design	....	...	....	3	3	.....	.....	10 00	10 00
							$439 20	$1,505 00	
								439 20	
Totals	251	97	183	340	871	$251 75		$1,944 20	$2,195 95

Publications.

The following list comprises the books and papers published by members of the Faculty and Instructing Staff during the past year. The publications are arranged according to departments, and the authors' names according to seniority.

Courses I. and XI. Civil and Sanitary Engineering.

G. F. Swain: Technical Education at the Massachusetts Institute of Technology. Popular Science Monthly, July, 1900.

C. F. Allen: Railroad Curves and Earthwork.

A. E. Burton: The M. I. T. Eclipse Expedition to Washington, Ga. Technology Review, July, 1900.

A. E. Burton, with A. G. Robbins and G. L. Hosmer: The Eclipse Expedition of the Massachusetts Institute of Technology to Washington, Ga. Technology Quarterly, September, 1900.

G. L. Hosmer: Summer School of Engineering at Lake Sunapee, June, 1900. Technology Review, October, 1900.

Course II. Mechanical Engineering.

G. Lanza: Applied Mechanics. New edition.

G. Lanza: Road Tests of Locomotives. Proceedings of the Central Railroad Club.

C. H. Peabody: Manual of the Steam Engine Indicator.

J. Sondericker: Notes on Graphical Statics. Revised edition.

E. F. Miller: Testing the Strength of Materials. Four articles in Machinery for February, March, April, and July, 1900.

E. F. Miller (Editor): Results of Tests made in the Engineering Laboratories, Number XII. Technology Quarterly, September, 1900.

S. H. Woodbridge: Car Sanitation. Report of the Public Health Association for 1899.

S. H. Woodbridge: Railroad Sanitation. Proceedings of the New England Railroad Club for November, 1899.

S. H. Woodbridge: Warming and Ventilation of Mills. Proceedings of the New England Cotton Manufacturers' Association for April, 1900.

Course III. Mining Engineering and Metallurgy.

R. H. Richards: Review of the Literature on Ore Dressing in 1898. The Mineral Industry, 1899, Vol. VIII., pp. 694–701.

R. H. Richards: Ore Dressing. The Mineral Industry, 1899, Vol. VIII., pp. 744–779.

H. O. Hofman: Notes on the Metallurgy of Iron and Steel. Printed for the use of students at the Institute.

H. O. Hofman: Recent Improvements in Lead Smelting. The Universal Industry, 1899, Vol. VIII., pp. 394–410.

H. O. Hofman: The Temperatures at which Certain Ferrous and Calcic Silicates are formed in Fusion, and the Effect upon these Temperatures of the Presence of Certain Metallic Oxides. Transactions of the American Institute of Mining Engineers, 1899, Vol. XXIX., pp. 682–721.

R. W. Lodge: Assaying Telluride Ores for Gold. Technology Quarterly, 1899, Vol. XII., pp. 171–174.

Course IV. Architecture.

E. B. Homer: A Day in Provence. Technology Review, January, 1900; and American Architect, Nos. 1279 and 1280.

Courses V. and X. Chemistry and Chemical Engineering.

H. P. Talbot with M. Henze: Darstellung der geometrisch-isomeren symmetrischen Di-methylaethylene aus der Tiglinsäure und Angelicasäure. Liebig's Annalen der Chemie, Vol. CCCXIII., p. 228.

A. A. Noyes with A. A. Blanchard: Lecture Experiments Illustrating the Electrolytic Dissociation Theory and the Laws of the Velocity and Equilibrium of Chemical Change. Journal of the American Chemical Society, Vol. XXII., p. 726.

A. A. Noyes: The Exact Relation between Osmotic Pressure and Vapor Pressure. Zeitschrift für physikalische Chemie, Vol. XXXV., No. 5; and Physical Review, Vol. XII., No 2.

A. A. Noyes: A Modification of the Usual Method of Determining Transference-Numbers and an Investigation of the Influence of the Concentration on their Values in the case of Some Tri-ionic Salts. Zeitschrift für physikalische Chemie, Vol. XXXV., No. 6; and Physical Review, Vol. XII., No. 1.

A. A. Noyes, Editor: Review of American Chemical Research for 1900. Reviewers: H. P. Talbot, F. J. Moore, A. G. Woodman, G. W. Rolfe, A. A. Noyes, W. O. Crosby, C.

H. Warren, Henry Fay, H. O. Hofman, J. F. Norris, H. M. Goodwin, E. H. Richards, A. H. Gill, and F. H. Thorp.

A. H. Gill: A Short Handbook of Oil Analysis. Second edition.

A. H. Gill with W. O. Adams: On Hübl's Iodine Method for Oil Analysis. Journal of the American Chemical Society, Vol. XXII., pp. 12–14.

Ellen H. Richards with A. G. Woodman: Water, Air, and Food from a Sanitary Standpoint.

Ellen H. Richards: University Laboratories in Relation to the Investigation of Public Health Problems and to Commercial Work. Transactions of the American Public Health Association, Vol. XXV.

S. P. Mulliken with H. Scudder: The Detection of Methyl Alcohol in Mixtures. American Chemical Journal, Vol. XXIV., p. 444.

J. F. Norris with H. Fay and D. W. Edgerly: The Preparation of Pure Tellurium. American Chemical Journal, Vol. XXIII., p. 105.

J. F. Norris with H. Fay: The Reduction of Selenium Dioxide by Sodium Thiosulphate. American Chemical Journal, Vol. XXIII., p. 119.

J. F. Norris with R. Mommers: The Isomorphism of Selenium and Tellurium. American Chemical Journal, Vol. XXIII., p. 486.

F. J. Moore: Ueber Abspaltung einer Sulfogruppe durch reducirende Agentien. Berichte der Deutschen Chemischen Gesellschaft, XXXIII., p. 2014.

H. Fay with S. Badlam: Heat Treatment and Micro-Structure of Low Carbon Steels. Technology Quarterly, December, 1900.

Courses VI. and VIII. Electrical Engineering and Physics.

C. R. Cross: Historical Notes Relating to Musical Pitch in the United States. Proceedings of the American Academy of Arts and Sciences, Vol. XXXV., No. 22, 1900.

W. L. Puffer: Report on "Grounding of the Neutral" to Underwriters' National Electric Association, 1900.

W. L. Puffer: Notes on Dynamo Testing. Third Revised Edition. Printed for use of students in the Institute.

H. E. Clifford: Notes on Heat. Printed for use of students in the Institute.

F. A. Laws: An Apparatus for Recording Alternating Current Waves. Proceedings of the American Academy of Arts and Sciences, Vol. XXXVI., No. 17, 1901.

H. M. Goodwin with F. W. Grover: The Effect of Temperature, of Colloidal Ferric Hydrate, and of a Magnetic Field on the Hydrolysis of Ferric Chloride. Physical Review, Vol. II., p. 193, 1900; and Technology Quarterly, Vol. XIII., p. 327, December, 1900.

W. L. Smith: A Study of Certain Shades and Globes for Electric Lights, Part 1. Technology Quarterly, Vol. XIII., p. 3, September, 1900.

L. Derr: Tests on Railroad Signal Glass. Proceedings of the New England Railroad Club, May, 1900.

L. Derr: Automobile Vehicles. Journal of the Association of Engineering Societies, July, 1900.

C. L. Norton: Tests of Fire Retardent Materials. Technology Quarterly, Vol. XIII., p. 1, June, 1900.

C. L. Norton: The Diffusion of Light through Windows. Report to Associated Factory Mutual Companies of New England. October, 1900.

J. G. Coffin: The Reflection of Light in the Neighborhood of the Critical Angle. Technology Quarterly, Vol. XIII., p. 2, June, 1900.

Course VII. Biology.

T. Hough: Review of Swedish Gymnastics. Boston. George H. Ellis, Printer. Reprinted in Report of United States Commissioner of Education, 1898–1899.

T. Hough: The Physiological Significance of the Flow of

Lymph and its Relation to Muscular Exercise. American Physical Education Review, Vol. V., No. 2, 1900.

T. Hough: Ergographic Experiments upon Muscular Fatigue and Soreness. Journal of the Boston Society of Medical Sciences, Vol. V., November, 1900.

R. P. Bigelow: A Study of Heredity among the Deaf. (Review of "Marriages of the Deaf in America," by E. A. Fay.) American Naturalist, Vol. XXXIV., No. 398, February, 1900.

R. P. Bigelow: Articles "Allantois," "Area Embryonalis," and "Biology," Wood's Reference Handbook of the Medical Sciences, Vol. I., 1900.

R. P. Bigelow: The Anatomy and Development of Cassiopea xamachana. Memoirs of the Boston Society of Natural History, Vol. V., No. 6, August, 1900.

Course IX. General Studies.

W. Z. Ripley: Capitalization of Public Service Corporations. Quarterly Journal of Economics, November, 1900.

Course XII. Geology.

W. O. Crosby: Geological History of the Nashua Valley during the Tertiary and Quaternary Periods. Technology Quarterly, December, 1899.

W. O. Crosby: Report on the Borings for the East Boston Tunnel. Appendix to Annual Report of the Boston Transit Commission, 1899.

W. O. Crosby: Outline of the Geology of Long Island in its Relation to the Public Water Supplies. Technology Quarterly, June, 1900.

W. O. Crosby: Notes on the Geology of the Sites of the Proposed Dams in the Valleys of the Housatonic and Ten Mile Rivers. Freeman's Report on New York's Water Supply, and Technology Quarterly, June, 1900.

W. O. Crosby: The Origin of Phenocrysts and the Devel-

opment of the Porphyritic Texture in Igneous Rocks. The American Geologist, May, 1900.

W. O. Crosby: The Blue Hills Complex. Occasional Papers of the Boston Society of Natural History, Vol. IV., Part 3.

G. H. Barton: Outline of Elementary Lithology.

M. L. Fuller: The Occurrence and Uses of Mica. Stone, Vol. XIX., No. 6, November, 1899.

M. L. Fuller: An Instance of Sub-Aqueous Differential Weathering. American Geologist, Vol. XXV., No. 6, June, 1900.

Department of Mathematics.

D. P. Bartlett: General Principles of the Method of Least Squares, with Applications. Second Edition.

F. S. Woods: Review of Lobachevsky's Geometry. Bulletin of the American Mathematical Society, May and July, 1900.

STATISTICS.

The Corps of Instructors.

The catalogue of this year shows the number of instructors of all grades to be 139, inclusive of those concerned with the mechanic arts, but exclusive of those who are announced as lecturers for the year only. The addition of these raises the total to 181. This year's catalogue will show an increase of five in the number of lecturers and some changes in the grades of professors and instructors. Reference has already been made to the augmentation of the number of the instructing staff; without counting lecturers, the number of instructors to that of students bears the proportion of one to nine and two-tenths. This proportion is a most characteristic figure, and is intimately associated with the quality of the instruction. The following table shows the distribution among the several classes of instructors, in comparison with last year:

	1899–1900.	1900–1901.
Professors	24	25
Associate Professors	9	11
Assistant Professors	21	27
Instructors	46	44
Assistants	35	32
Lecturers	37	42
Total	172	181

Students and Graduates.

The registration of this year, as by the catalogue now in press, amounts to 1,277. The following table shows the registration of successive years from the foundation of the Institute:

Year.	No. of Students.	Year.	No. of Students.
1865–66	72	1883–84	443
1866–67	137	1884–85	579
1867–68	167	1885–86	609
1868–69	172	1886–87	637
1869–70	206	1887–88	720
1870–71	224	1888–89	827
1871–72	261	1889–90	909
1872–73	348	1890–91	937
1873–74	276	1891–92	1,011
1874–75	248	1892–93	1,060
1875–76	255	1893–94	1,157
1876–77	215	1894–95	1,183
1877–78	194	1895–96	1,187
1878–79	188	1896–97	1,198
1879–80	203	1897–98	1,198
1880–81	253	1898–99	1,171
1881–82	302	1899–1900	1,178
1882–83	368	1900–1901	1,277

Students by Classes.

The aggregate number of students for 1900–1901 is divided among the several classes as follows:

Fellows	7
Graduate students, candidates for advanced degrees	5
Regular students, Fourth Year	193
" " Third "	184
" " Second "	205
" " First "	340
Special students	345
Total	1,279
Counted twice	2
	1,277

Assigning the special students to classes, according to the predominant studies pursued by them, we reach the following division of the whole body among the several years:

Class.	Regular.	Special.	Total.
Fellows and Graduates of the M.I.T.	10	...	10
Fourth Year	193	80	273
Third Year	184	110	294
Second Year	205	121	326
First Year	340	34	374
Total	932	345	1,277

THE COURSES OF INSTRUCTION.

The following table presents the number of the regular students in the second, third, and fourth years, by courses:

YEAR.	Civil Engineering.	Mechanical Engineering.	Mining Engineering and Metallurgy.	Architecture.	Chemistry.	Electrical Engineering.	Biology.	Physics.	General Course.	Chemical Engineering.	Sanitary Engineering.	Geology.	Naval Architecture.	Total.
4th Year Class.	37	35	16	20	20	27	1	2	5	15	4	1	11	193
3d " "	20	45	18	19	14	31	5	1	2	9	8	...	12	184
2d " "	32	47	35	14	16	29	...	1	1	10	5	...	15	205
Total . . .	89	127	69	53	50	87	6	4	8	34	17	1	38	582*

The following table shows the figures of the total line in the foregoing table, in comparison with the corresponding figures for the next ten preceding years:

YEAR.	Civil Engineering.	Mechanical Engineering.	Mining Engineering and Metallurgy.	Architecture.	Chemistry.	Electrical Engineering.	Biology.	Physics.	General Course.	Chemical Engineering.	Sanitary Engineering.	Geology.	Naval Architecture.	Total.
1890 . . .	79	95	18	27	27	105	11	4	13	18	7	3	...	407
1891 . . .	81	104	17	33	23	108	11	5	19	28	9	3	...	441
1892 . . .	76	106	19	37	35	112	9	5	16	34	5	3	...	457
1893 . . .	78	97	22	50	39	141	4	10	19	31	10	2	8	511
1894 . . .	88	111	19	48	50	137	5	9	19	35	13	1	20	556*
1895 . . .	88	118	25	67	59	126	7	11	14	25	10	3	22	575
1896 . . .	99	117	24	65	66	106	7	11	11	34	8	...	25	573
1897 . . .	109	119	38	71	60	90	8	9	10	36	7	1	26	578*
1898 . . .	93	108	52	64	64	94	6	8	12	38	7	1	33	574*
1899 . . .	99	113	60	53	58	84	8	7	11	30	14	1	38	575*
1900 . . .	89	127	69	53	50	87	6	4	8	34	17	1	38	582*

* Deducting those counted twice.

The following table shows, by classes and by courses, the number of regular students who have registered themselves as electing to distribute the required studies and exercises over the period of five years:

Year.	Total.	Course.												
		I.	II.	III.	IV.	V.	VI.	VII.	VIII.	IX.	X.	XI.	XII.	XIII.
1st . . .	3	..	..	..	..	..	..	..	..	..	..	..	..	..
2d . . .	2	..	1	..	..	..	1	..	..	..	..	..	..	..
3d . . .	9	2	2	2	..	1	1	..	..	..	..	..	..	1
4th . . .	17	4	4	3	..	..	3	..	..	1	1	1	..	..
5th . . .	4	1	1	1	..	..	1	..	..	..	..	..	..	..
	35	7	8	6	..	1	6	..	..	1	1	1	..	1

Classification of Special Students.

Our special students can, of course, not be classified systematically; but the following table exhibits the number of such students pursuing certain leading lines of study:

Applied Mechanics . . .	89	Language	144
Architecture	40	Mathematics	166
Biology	39	Mechanical Engineering . .	106
Chemistry	111	Mining Engineering . . .	18
Civil Engineering	57	Naval Architecture	13
Drawing	135	Physics	207
Electrical Engineering . .	25	Political Science	75
English	105	Sanitary Engineering . . .	1
Geology	47	Shopwork	83
History	83		

The following is the number of students, either regular or special, pursuing certain leading branches of study, in each of the four years:

	First Year.	Second Year.	Third Year.	Fourth Year.	Total.
Mathematics . .	376	288	143	37	844
Chemistry . . .	389	67	66	71	593
English	336	272	22	8	638
French	151	88	49	...	288
Physics	...	319	293	181	793
German	83	195	151	1	430
Shopwork . . .	19	144	54	78	295

Residence of Students.

States.	Candidates for Advanced Degrees.	Fourth Year.	Third Year.	Second Year.	First Year.	All Regular Students.	Special Students.	Total.
Alabama	..	..	..	..	..	..	1	1
Arkansas	..	..	..	..	1	1	..	1
California	..	1	..	1	2	4	6	10
Colorado	..	..	2	1	1	4	4	8
Connecticut	..	6	6	4	10	26	9	35
Delaware	..	2	..	..	..	2	2	4
Dist. of Columbia	..	1	2	2	6	11	2	13
Florida	..	..	..	..	1	1	0	1
Georgia	..	..	..	1	1	2	1	3
Hawaiian Islands	..	1	..	..	..	1	..	1
Illinois	..	8	7	6	7	28	11	39
Indiana	..	..	..	4	..	4	3	7
Iowa	1	1	1	..	4	7	3	10
Kentucky	..	2	..	2	..	4	1	5
Louisiana	..	1	..	..	..	1	1	2
Maine	..	1	3	5	7	16	6	22
Maryland	..	1	..	2	6	9	4	13
Massachusetts	9	119	114	123	223	588	191	779
Michigan	..	1	2	2	1	6	2	8
Minnesota	..	3	2	1	1	7	..	7
Missouri	..	1	1	1	4	7	6	13
Montana	..	..	..	1	2	3	2	5
Nebraska	..	..	..	..	2	2	2	4
Nevada	..	1	..	..	..	1	..	1
New Hampshire	..	4	2	9	3	18	8	26
New Jersey	..	1	3	1	2	7	1	8
New York	..	13	9	7	23	52	16	68
North Carolina	..	..	..	..	..	..	2	2
Ohio	..	7	..	5	7	19	8	27
Oregon	..	..	..	..	..	..	1	1
Pennsylvania	..	5	6	9	7	27	10	37
Rhode Island	..	3	5	8	6	22	13	35
South Carolina	..	..	..	1	..	1	..	1
South Dakota	..	..	..	1	..	1	..	1
Tennessee	..	..	..	1	..	1	5	6
Texas	..	..	..	1	1	2	2	4
Utah	..	1	2	1	2	6	1	7
Vermont	..	2	5	..	2	9	6	15
Virginia	..	..	1	1	..	2	1	3
Washington	..	..	..	1	1	2	..	2
West Virginia	..	..	..	..	..	..	1	1
Wisconsin	..	1	3	1	1	6	2	8
Foreign Countries.								
Bermuda	..	..	..	..	..	..	1	1
Denmark	..	1	..	..	..	1	..	1
England	..	1	1	..	1	3	..	3
France	..	..	2	1	1	4	..	4
Germany	..	..	1	..	1	2	..	2
Jamaica	..	..	..	..	..	..	1	1
Japan	..	..	..	..	..	..	2	2
Mexico	..	2	1	..	1	4	3	7
New Brunswick	..	1	1	..	..	2	..	2
Nova Scotia	..	..	..	1	1	2	..	2
Quebec	..	1	..	..	1	2	2	4
Russia	..	..	..	..	..	..	1	1
Turkey	..	..	2	..	..	2	1	3
Total	10	193	184	205	340	932	345	1277

Forty States of the Union, besides the District of Columbia and Hawaiian Islands, are represented on our list of students. Of the total number of 1,277, 779 are from Massachusetts, or 60.9 per cent. of the whole; 133 are from other New Eng-

land States; 366 are from outside New England. Of these, 33 are from foreign countries.

A table showing the number of students in each year, from 1894, coming from each State or Territory, and from each foreign country, may be not without interest and instruction:

States.	1894.	1895.	1896.	1897.	1898.	1899.	1900.
Alabama	1	..	1	1	1	..	1
Arkansas	..	..	1	1	..	..	1
California	9	8	9	9	11	9	10
Colorado	8	7	7	8	8	7	8
Connecticut	29	27	24	30	26	29	35
Delaware	4	5	5	6	3	4	4
Dist. of Columbia	12	16	17	13	8	7	13
Florida	2	1	..	1	..	1	1
Georgia	2	2	3	4	4	3	3
Hawaiian Islands	..	..	..	..	1	..	1
Idaho	..	1	1	1	..	..	..
Illinois	36	42	45	40	51	36	39
Indiana	3	2	3	7	3	5	7
Iowa	10	12	14	12	7	6	10
Kansas	4	4	3	3	..	..	..
Kentucky	12	11	12	10	10	4	5
Louisiana	3	2	..	1	1	1	2
Maine	38	38	27	24	19	25	22
Maryland	4	9	9	8	8	8	13
Massachusetts	708	721	730	739	719	731	779
Michigan	8	7	6	5	9	10	8
Minnesota	10	5	7	8	11	10	7
Missouri	14	9	11	6	10	11	13
Montana	2	1	3	5	2	3	5
Nebraska	4	2	2	2	1	3	4
Nevada	2	..	..	..	..	1	1
New Hampshire	28	30	26	25	25	29	26
New Jersey	5	5	13	15	13	12	8
New Mexico	1	1	..	..	..	..	..
New York	59	64	69	62	68	61	68
North Carolina	..	..	1	1	2	2	2
Ohio	50	37	28	30	23	27	27
Oregon	1	1	4	3	3	2	1
Pennsylvania	37	36	42	41	34	33	37
Rhode Island	26	21	20	19	23	32	35
South Carolina	3	5	6	4	1	1	1
South Dakota	..	..	..	..	..	1	1
Tennessee	1	1	1	3	3	4	6
Texas	6	3	2	2	1	2	4
Utah	2	5	2	3	5	6	7
Vermont	3	5	7	11	12	12	15
Virginia	2	5	3	4	3	2	3
Washington	3	1	5	4	7	4	2
West Virginia	1	3	2	1	..	1	1
Wisconsin	6	7	6	6	8	7	8
Wyoming	..	..	1	..	..	..	..
Foreign Countries.							
Belgium	1	..	..	..	..	..	..
Bermuda	..	..	..	..	..	..	1
Brazil	1	1	..	..	..	..	..
Bulgaria	..	..	..	..	..	..	..
Cape Breton	..	..	..	..	1	..	..
Central America	..	1	..	..	..	..	..
Chile	1	1	1	..	..	..	..
Columbia	..	..	..	..	..	..	..
Cuba	1	3	2	1	1	..	..
Denmark	..	..	..	2	1	1	1
Dutch Guiana	..	..	..	..	1	1	..
England	..	2	2	2	4	1	3
France	..	..	1	1	1	2	4
Germany	1	..	..	..	1	1	2
Guatemala	..	..	..	.	..	..	..
Holland	2	..	..	..	..	..	..
Ireland	1	..	.	..	..	.	..
Jamaica	..	..	..	..	..	1	1
Japan	1	2	2	..	1	2	2
Mexico	1	1	3	6	7	7	7
New Brunswick	1	1	2	2	3	3	2
New South Wales	1	1	..	..	..	..	..
Nova Scotia	1	2	1	1	2	..	2
Ontario	4	2	2	..	..	..	..
Peru	..	..	..	..	..	..	..
Porto Rico	1	1	..	..	..	..	..
Quebec	2	2	2	2	1	3	4
Russia	..	..	..	..	..	1	1
Scotland	1	..	..	..	..	..	..
Spain	1	1	..	..	..	..	..
Trinidad	..	..	..	..	..	..	..
Turkey	1	3	1	3	3	3	3
Venezuela	1	1	1	..	..	..	..
Total	1183	1187	1198	1198	1171	1178	1277

Residence of Massachusetts Students.

It has been said that 60.9 per cent. of our students are from Massachusetts. All the counties of the State except Dukes send students to the Institute. One hundred and thirty-four cities and towns are on the lists. The first column of

the following table shows the number of cities and towns in each county sending pupils; the second column gives the aggregate number from each county. It appears that Middlesex sends two hundred and forty-four and Suffolk two hundred and twenty pupils; Essex comes third, with one hundred and ten; Norfolk fourth, with seventy-four.

County.	No. of Towns.	No. of Students.	County.	No. of Towns.	No. of Students.
Barnstable	4	5	Middlesex	36	244
Berkshire	3	4	Nantucket	1	1
Bristol	8	19	Norfolk	17	74
Essex	22	110	Plymouth	13	38
Franklin	4	7	Suffolk	4	220
Hampden	6	25	Worcester	15	30
Hampshire	2	2			
			Total	135	779

The following is a list of the towns, forty-two in number, which send four or more students to the Institute:

Boston	200	Salem	11	Haverhill	5
Newton	51	Gloucester	11	Holyoke	5
Cambridge	39	Hyde Park	9	Marlboro	5
Newburyport	25	Malden	9	Medford	5
Lowell	23	Waltham	9	Taunton	5
Brookline	19	Fitchburg	7	Canton	4
Somerville	18	Natick	7	Dedham	4
Lawrence	17	Quincy	7	Framingham	4
Chelsea	16	Wellesley	7	Peabody	4
Springfield	16	Winchester	7	Plymouth	4
Brockton	14	Andover	6	Stoughton	4
Lynn	13	Everett	6	Wakefield	4
Arlington	12	Middleboro	6	Woburn	4
Melrose	11	Milton	6	Worcester	4

The following table exhibits for ten years the distribution of the total number of students among two classes: First, those students whose names are found upon the Catalogue of the year preceding; and secondly, those whose names appear

first upon the Catalogue of the year to which the statement relates:

Year.	(1) Total No. of Students.	(2) No. of Students in the Catalogue of the previous year who remain in the Institute.	(3) No. of New Students entering before issue of Catalogue.	(4) Of those in column (3) the following number are regular First-year Students.	(5) No. of New Students not of the regular First-year Class.
1891–92	1,011	624	387	258	129
1892–93	1,060	618	442	303	139
1893–94	1,157	701	456	301	155
1894–95	1,183	768	415	271	144
1895–96	1,187	778	409	266	143
1896–97	1,198	758	440	263	177
1897–98	1,198	757	441	277	164
1898–99	1,171	769	402	278	124
1899–1900	1,178	764	414	275	139
1900–1901	1,277	789	488	312	176

Ages of Students on Entrance.

The next table exhibits the ages of our students upon entrance, after taking out three who are repeating the first year, and twenty-eight persons of unusual ages. These deductions leave three hundred and nine as the number of students whose ages have been made the subject of computation.

Period of Life.	1899-1900.		1900-1901.	
	Half-year Groups.	Yearly Groups.	Half-year Groups.	Yearly Groups.
16 to 16½ years	2	..	1	...
16½ to 17 "	3	5	4	5
17 to 17½ "	16	..	10	..
17½ to 18 "	32	48	41	51
18 to 18½ "	57	..	53	..
18½ to 19 "	52	109	65	118
19 to 19½ "	34	..	55	..
19½ to 20 "	40	74	30	85
20 to 20½ "	28	..	25	..
20½ to 21 "	11	39	18	43
21 to 22 "	8	8	7	7
	283	283	309	309

The results appear in the table above in comparison with the corresponding results of 1899–1900.

From the foregoing it appears that the average age on entrance is eighteen years and ten months.

In this connection are presented the ages, at graduation, of the class leaving us in June. The one hundred and seventy-eight members of the class were distributed among the different periods of life as follows:

Under 20½	3
Between 20½ and 21	8
" 21 " 21½	16
" 21½ " 22	25
" 22 " 23	57
" 23 " 24	31
" 24 and over	38
Total	178

The special students this year constitute twenty-seven per cent. of the whole body, as against twenty-six per cent. last year and twenty-seven per cent. the year before.

Graduates of Other Colleges.

The number of students who are graduates of this and other institutions is ninety-eight. Of these seven are our own graduates, five being candidates for advanced degrees.

Ninety-one are graduates of other institutions, pursuing courses of study with us either as regular or as special students. Twenty-two are graduates of Harvard University; three each of Amherst and Yale Colleges, and five of Brown University; two each of McGill and Vermont Universities, Davidson, Grove City, Neuchâtel, Mt. Holyoke, Southwestern, Presbyterian Colleges, and Worcester Polytechnic Institute; one each of Alabama, California, Chicago, Columbia, Denison, Japan, Lehigh, Leland Stanford Jr., Michigan, Nebraska, New York, Ohio State, Princeton, University of the South, Syracuse, Virginia, and Washington Universities; one each of Acadia,

Augustana, Bates, Beloit, Boston, Bowdoin, Bryn Mawr, Delaware, DePauw, Gallaudet, Monmouth, Randolph, Macon, Robert, St. Joseph, St. Xavier's, Smith, South Kentucky, Villanova, Washington and Lee, and Williams Colleges; one each of Harvard Medical School, and Virginia Military Institute.

Women as Students at the Institute.

The number of women pursuing courses with us is forty-four. Of these, four are graduates of colleges. Of the total number, three are regular students of the fourth year; four of the third year; six of the second year; eight of the first year. Twenty-three are special students. Of the thirteen regular students of the upper classes, four take Course IV., Architecture; two, Course V., Chemistry; three, Course VII., Biology; three, Course VIII., Physics; one, Course IX., General Studies. Of the special students, fourteen devote themselves to Biology, four to Chemistry, one to General Studies, one to Physics, one to Naval Architecture, and one to Geology.

Statistics of Examinations.

Of the 1,277 students of the present year, 788 were not connected with the school in 1899–1900. Of these, 310 were admitted as regular students of the first year upon the basis of their entrance examinations. The 177 remaining comprise (1) those who had previously been connected with the Institute, and have resumed their places in the school; (2) those who were admitted provisionally without examination; (3) those who were admitted by examination as regular second-year or as special students; (4) those who were admitted on the presentation of diplomas or certificates from other institutions of college grade. In addition to the 310 who were thus admitted to the first year on examination, and have taken their place in the school, 104 were admitted on examination, but have not entered the school.

In the case of the 310 persons who were admitted on examination, and have joined the school, the results of the examinations, embracing both those of June and those of September, were as follows:

Admitted clear	237
" on one condition	51
" on two conditions	18
" on more than two conditions	4
	310

Sixty-one applicants were rejected.

Examinations at Distant Points.

In addition to the entrance examinations held at Boston in July and September, examinations were conducted in July at Belmont, Buffalo, Chicago, Cincinnati, Cleveland, Denver, Detroit, Exeter (N.H.), Kansas City (Mo.), Louisville, Manlius (N.Y.), Newport, New York, Philadelphia, Pittsburgh, Portland (Me.), Pottstown, Poughkeepsie, St. Louis, Springfield (Mass.), and Washington.

The following table exhibits the number of persons who have graduated within each of the several courses since the foundation of the school:

Year.	Civil Engineering.	Mechanical Engineering.	Mining Engineering.	Architecture.	Chemistry.	Metallurgy.	Electrical Engineering.	Natural History or Biology.	Physics.	General Course.	Chemical Engineering.	Sanitary Engineering.	Geology.	Naval Architecture.	Total.
1868	6	1	6	..	..	..	..	..	..	1	..	..	..	..	14
1869	2	2	..	..	1	..	..	..	..	..	..	..	..	..	5
1870	4	2	2	..	1	..	..	..	..	1	..	..	..	..	10
1871	8	2	5	..	2	..	..	..	..	..	..	..	..	..	17
1872	3	1	5	..	3	..	..	..	..	..	..	..	..	..	12
1873	12	2	3	1	7	..	..	..	..	1	..	..	..	..	26
1874	10	4	1	1	..	..	..	..	..	2	..	..	..	..	18
1875	10	7	6	1	1	..	..	..	1	2	..	..	..	..	28
1876	12	8	7	..	5	1	..	2	3	4	..	..	..	..	42
1877	12	6	8	4	2	..	..	..	..	..	..	..	..	..	32
1878	8	2	2	3	3	..	..	..	..	1	..	..	..	..	19
1879	6	8	3	1	3	..	..	1	1	..	..	..	..	..	23
1880	3	..	3	..	1	..	..	..	..	1	..	..	..	..	8
1881	3	5	6	3	8	..	..	1	..	2	..	..	..	..	28
1882	2	5	5	3	6	..	..	1	1	1	..	..	..	..	24
1883	3	7	5	1	3	..	..	..	..	..	..	..	..	..	19
1884	5	6	13	..	12	..	..	..	..	..	..	..	..	..	36
1885	4	7	8	2	4	..	2	..	..	1	..	..	..	..	28
1886	9	23	7	1	7	..	10	1	..	1	..	..	..	..	59
1887	10	17	8	1	9	..	8	1	1	3	..	..	..	..	58
1888	11	25	4	5	10	..	17	3	1	1	..	..	..	..	77
1889	14	24	5	3	8	..	17	1	1	2	..	..	..	..	75
1890	25	28	3	5	13	..	18	3	2	6	..	..	..	..	103
1891	18	26	4	6	11	..	23	3	3	1	7	..	1	..	103
1892	22	26	4	13	7	..	36	6	1	7	4	6	1	..	133
1893	25	30	5	2	8	..	41	2	..	6	8	..	2	..	129
1894	21	31	4	14	11	..	33	1	3	5	12	3	..	..	138
1895	25	30	3	15	14	..	33	..	2	4	11	4	..	5	144*
1896	25	34	10	24	17	..	48	3	3	7	7	4	3	5	189*
1897	25	40	7	16	20	..	33	2	3	7	12	4	1	9	179
1898	32	41	7	29	26	..	33	3	4	6	9	3	..	7	200
1899	30	38	9	22	21	..	32	2	2	1	9	1	..	8	173*
1900	31	33	20	21	16	..	22	3	3	5	11	4	..	9	183†
Totals	436	521	188	197	260	1	406	39	35	79	90	29	8	43	2,332
Deduct names counted twice															12
Net total															2,320

* Deducting names counted twice.
† Including seven persons awarded degrees on the date of this report.

THE SOCIETY OF ARTS.

REPORT OF THE SECRETARY.

To the President of the Institute:

SIR: On behalf of the Executive Committee, I have the honor to present the annual report of the Society of Arts for the year May 11, 1899, to May 10, 1900.

The first meeting of the Society of Arts for the present year was held on Oct. 12, 1899. Fourteen meetings have been held, the average attendance being ninety persons. The following papers have been read: "Some Practical Applications of Storage Batteries," by Mr. J. S. Woodbridge; "Visual Signals," by Mr. H. C. Spaulding; "Use of Kites to Obtain Meteorological Data," by Prof. A. Lawrence Rotch; "New Cellulose Industries," by Mr. A. D. Little; "Exhibition of Building Stones and Minerals collected by the Geological Department of the Massachusetts Institute of Technology in Association with the Commissioners of Massachusetts and the United States for the Paris Exposition," by Professors Niles, Crosby, and Mr. Fuller; "The Character and Extent of Food and Drug Adulterations in Massachusetts, and the Systems of Inspection of the State Board of Health," by Mr. Albert E. Leach; "A New Dynamo-Static Machine," by Prof. Elihu Thomson; "An Architect's Tour through the Riviera and Central France," by Prof. E. B. Homer; "Massachusetts Roads, Old and New," by Mr. William E. McClintock; "Water Storage on the Gila River, Arizona," by Mr. F. H. Newell; "The Boston Elevated Railway System," by Gen. W. A. Bancroft; "Recent Changes of Opinion in England in Favor of the Bacterial Purification of Sewage," by Prof. L. P. Kinnicutt; "Lecture Room Models for illustrating the Modern Methods for Electric Transmission

of Power," by Prof. W. L. Puffer; "Steel, Gray, and Gun Iron Castings; Their Uses and Relative Values," by Prof. W. W. Bird.

At the first meeting of the year the resignation of the Secretary, Mr. Arthur T. Hopkins, was accepted, and Dr. Wendell elected to the position.

During the year there have been a number of changes in membership. Mr. William Jackson, City Engineer of Boston, has been elected to Life Membership, making the number of such members 47; of the Associate Members, 2 have died, 8 have resigned; 22 new members have, however, been elected, making the present membership 339.

In the death of Professor Silas W. Holman the Society lost one of its most distinguished members, and the Institute of Technology one of its most eminent teachers. While his health lasted he evinced a most active interest in the welfare of the Society, as its Secretary from 1881 to 1883, and by his many contributions to the "Quarterly." A sketch of his life will be found in the "Technology Review" for July, 1900.

The publication of the "Technology Quarterly" has been continued under the same management as last year. Since the last annual report, twenty papers have been published in the "Quarterly," of which six were read before the Society, the rest being presented only by title. Besides these, the Proceedings of the Society, and the Review of American Chemical Research, contributed by members of the Chemical Department, have appeared in each number. Mr. Axson's article on "Nitrates as a Product of Combustion" is the first of a new series of contributions from the Laboratory of Sanitary Chemistry. Two of the articles embody the results of notable pieces of work done by members of the Faculty. One, on the "Geological History of the Nashua Valley during the Tertiary and Quaternary Periods," by Professor W. O. Crosby, gives the scientific results of an extended investigation carried on under the auspices of the Metropolitan Water Commission. The other is by Professor Hofman on "The

Temperatures at which Certain Ferrous and Calcic Silicates are formed in Fusion, and the Effect upon these Temperatures of the Presence of Certain Metallic Oxides," a subject of great practical importance in metallurgy. The research was carried on under a grant from the C. M. Warren Fund of the American Academy of Arts and Sciences.

At the last meeting of the year, the thirty-eighth annual meeting, Messrs. George W. Blodgett, Desmond FitzGerald, Edmund H. Hewins, and Charles T. Main were reëlected members of the Executive Committee, and Mr. G. V. Wendell was reëlected Secretary for the year 1900–1901. Mr. James P. Munroe was elected to serve on the Executive Committee in place of Mr. Frank W. Hodgdon, resigned.

Respectfully submitted,

GEORGE V. WENDELL,

Secretary.

DECEMBER 1, 1900.

TREASURER'S REPORT.

STATEMENT OF THE TREASURER.

THE Treasurer submits the annual statement of the financial affairs of the Institute for the year ending Sept. 29, 1900.

Under the will of the late Robert C. Billings the Institute received $92,500 free from all conditions. The sum bequeathed was $100,000, but the succession tax reduced it to the above amount.

It will be remembered that in the last report acknowledgment was made of a gift of $50,000 from Augustus Lowell, Esquire, to constitute "The Teachers' Fund." Since Mr. Lowell's death, his executors have, in conformity with his wishes, added $50,000 more to the previous gift. This wise and generous bequest is an added proof of Mr. Lowell's great interest in the Institute, an interest to which it is most deeply indebted not only for generous financial aid, but for constant care and devotion in watching its interests, and helping to guide its development.

There has also been received from the estate of Henry L. Pierce the sum of $15,000, from the Trustees of the J. W. and Belinda Randall Charity $8,452.36, from the estate of Mrs. Julia B. H. James $17,154.21, and from that of Miss Susan E. Dorr $2,061.55, all of which sums are in addition to large amounts previously received from the same sources. Besides these sums a gift of $500 came from a friend of the Institute, and Francis Blake, Esquire, kindly contributed $100 toward the cost of a telescope.

One transaction of very especial importance to the future of the Institute has been completed during the past year, viz., the purchase of some fifty-two thousand feet of land bounded by Trinity place, Stanhope street, and Clarendon street extended and immediately adjoining other land owned by the Institute on Clarendon street and Trinity place. The change in the location of the Boston & Providence Railroad tracks offered this opportunity, and it is believed that the purchase is a very wise one in view of the future needs of the Institute. The immediate result, however, of sinking so large a sum of money in unproductive real estate is to diminish our annual income, and we start the new year with a smaller amount of interest-bearing property than we had a year ago. The total amount, however, of the Institute property, both real and personal, has been increased during the year by a net amount of $219,853.07, after deducting the sum of $8,593.54, which is the excess of expenses over income. In addition to the gifts above referred to, there has been a profit on securities sold during the year of $40,446.51.

In the items of salaries and department supplies there has been a decided increase during the year, but the charges for repairs and general expenses are much smaller than in the previous year. It will be noted that the annual deficit in current expense account is more than $11,000 less than in 1899.

While the Institute's property has of late years increased rapidly, it must be borne in mind that a very large proportion of its funds are held for scholarship or kindred purposes, so that of the total income from securities and rents more than one-quarter is so used. In addition to this there are twenty free State scholarships and twenty more for which the State has paid annually $4,000.

SECURITIES SOLD OR PAID, W. B. ROGERS MEMORAL FUND.

$2,000	Ottawa, Oswego & Fox River R.R. 8s	1900	2,000.00

RECEIVED.

$3,000	Chi., Mil. & St. Paul R.R. 7s. transferred from General Funds	1905	3,613.18

SECURITIES SOLD OR PAID, GENERAL ACCOUNT.

$1,000	Bur. & Mo. River (Neb.) R.R. 6s., non-ex.	1918	1,000.00
1,000	Chi., Burlington & Quincy R.R. 4s.	1922	1,000.00
3,000	Chi., Mil. & St. Paul R.R. 7s. transferred to Rogers Fund	1905	3,613.18
4,000	Chi., Bur. & Northern R.R. 5s.	1926	4,200.00
31,000	Walter Baker Co. Lt'd. 4½s.	1903	31,000.00
250,000	New York Revenue 3½s.	1899	250,000.00
26 Sh.	Boston & Albany R.R.		6,226.50
194 "	Morris & Essex R.R.		17,945.00
49 "	New York & Harlem R.R.		8,060.00
85 "	Pittsburgh, Fort Wayne & C. R.R.		15,895.00
100 "	N. Y., New Haven & Hartford R.R.		21,211.25
50 "	Boston & Maine R.R., common		9,750.00
25 "	Boston & Providence R.R.		7,490.00
50 "	Fitchburg R.R., Pf.		6,100.00
90 "	Pullman's Palace Car Co.		17,010.00
59 "	Everett Mills		5,815.00
6 "	Manchester Mills		600.00
1 "	Merrimack Manf. Co.		1,150.00
158 "	Pennsylvania Coal Co.		32,390.00
40 "	Cambridge Gas Light Co.		9,600.00
10 "	National Union Bank		1,358.75
5 "	First Nat. Bank of Baltimore		825.00
50 "	American Bell Telephone Co.		15,600.00
55 "	New England Tel. & Tel. Co.		7,475.00
40	Rights The Molsons Bank, Montreal		70.00
			$475,384.68

SECURITIES BOUGHT OR RECEIVED AS LEGACIES, GENERAL ACCOUNT.

$25,000	Chi. Terminal & Transfer Co. 1st 4s.	1947	24,520.00
95,000	Illinois Steel Co. Non-conv. 5s.	1913	95,296.25
50,000	Long Island R.R. 4s.	1949	46,637.50
7,000	K. C., Clinton and Springfield R.R. 5s.	1925	6,289.21
8,500	K.C., Mem. & Birmingham R.R. 4s.	1934	8,287.50
13,000	K. C., St. Jo. & Council Bluffs R.R, 7s.	1907	15,210.00
50,000	Kansas City Stock Yards 5s.	1910	57,664.90
25,000	Atchison, Top. & St. Fé R.R. 4s.	1995	25,281.25
50,000	Rio Grande & Western R.R. 4s.	1939	49,180 00
50,000	Oregon R.R. & Navigation Co. 4s.	1946	51,375.00
50,000	Union Pacific R.R. 4s.	1947	52,000.00
100,000	Chi. & West Michigan R.R. 5s.	1921	102,205.00
100,000	American Tel. & Tel. Co. 4s.	1929	99.875.00
50,000	New England Tel & Tel. Co. 4s.	1930	50,625.00
50,000	Chi. Junc. & Union Stock Yards 4s.	1940	49,250.00
			$733,696.61

GEORGE WIGGLESWORTH, TREASURER, *in account with*
GENERAL STATEMENT OF RECEIPTS AND DISBURSEMENTS

Dr.

Cash balance, Sept. 30, 1899		61,746.50
From Augustus Lowell for Lowell Courses	6,000.00	
" " " " C. Kastner's salary	2,500.00	
" " " " School of Design	500.00	
		9,000.00
RECEIPTS FOR CURRENT EXPENSES.		
Income of funds for salaries	4,304.00	
" " " " scholarships (students' fees)	7,775.00	
" " " " Joy "	200.00	
" " " " Swett "	400.00	
" " " " Savage "	400.00	
" " " " W. B. Rogers	525.00	
" " " " Library	480.00	
" " " " general purposes	14,876.18	
" " Rogers Memorial Fund	10,900.48	
" " Charlotte B. Richardson Fund	1,495.15	
" " Rotch Prize Funds	400.00	
" " Rotch Architectural Fund	1,000.00	
" " Edward Austin Fund, Scholarships	8,215.00	
" " " " " Awards	4,169.36	
" " Teachers' Fund "	1,000.00	
Letter Box Fund [1899, 31.00]	125.00	
Students' fees	200,744.93	
State Scholarships	4,000.00	
United States Act of 1862	2,188.59	
United States Act of 1890	8,333.34	
Gift of State of Massachusetts	25,000.00	
Laboratory supplies and breakages	10,829.84	
Rents, per Table (page 68)	12,575.10	
Gifts	600.00	
Interest	22,882.78	
Boston University	1,150.00	
Sale printed Lecture Notes	2,562.72	
		347,132.47
GIFTS AND BEQUESTS FOR SPECIAL PURPOSES.		
Increase Scholarship Funds	785.57	
" Teachers' Fund [add'l 50,000.00]	51,000.00	
" Edward Austin Fund	1,215.64	
" Susan E. Dorr Fund [add'l 2,061.55]	2,388.32	
		55,389.53
GIFTS AND BEQUESTS FOR GENERAL PURPOSES.		
Henry L. Pierce Legacy, additional	15,000.00	
James Fund, additional	17,154.21	
J. W. and Belinda Randall Fund, additional,	8,452.36	
Robert C. Billings Legacy	92,500.00	
		133,106.57
SECURITIES SOLD OR PAID. GENERAL FUND, page 59.		475,384.68
" " " Rogers Memorial Fund		2,000.00
SUNDRIES.		
Income credited to Bond Premium Acct.	3,356.15	
Income credited to Rogers Bond Premium Acct.	712.52	
Boston Art Students' Association, on acc't	666.67	
Students' Notes paid and charged off	415.00	
Notes Receivable	316,500.00	
		321,650.34
		$1,405,410.09

MASSACHUSETTS INSTITUTE OF TECHNOLOGY.

FOR THE YEAR ENDING SEPT. 29, 1900.

Cr.

Paid for Lowell Courses	6,000.00	
" " Charles Kastner's salary	2,500.00	
" " Expense Lowell School of Design	500.00	
		9,000.00
EXPENSES.		
Salaries, per Table (page 68)	249,072.05	
" paid from Gifts	500.00	
Fellowship paid from Swett Fund	400.00	
" " " Savage "	400.00	
Edward Austin Fund, Awards	4,169.36	
Teachers' Fund	1,000.00	
Prizes, Rotch Funds	400.00	
Repairs, per Table (page 69)	12,406.00	
General Expenses, per Table (page 69)	16,707.40	
Fire Insurance	2,338.61	
Fuel	7,339.11	
Water	2,161.90	
Gas	2,187.65	
Electricity	1,627.55	
Printing and Advertising	3,987.28	
" Lecture Notes	4,626.85	
" Annual Catalogues and Reports	2,434.93	
Rents paid Boston & Albany R.R. Co.	180.00	
" " Natural History Society	200.00	
Laboratory Supplies and Libraries, per Table (page 68)	41,487.55	
Society of Arts	127.84	
Interest paid A. Lowell, Trustee	1,000.00	
Paris Exposition	971.93	
		355,726.01
[Expenses more than Income, $8,593.54]		
SECURITIES BOUGHT OR RECEIVED AS LEGACIES.		
General Account (page 59)		733,696.61
Rogers Memorial Fund		3,613.18
Henry L. Pierce Building, Trinity Place, on acct.		1,421.59
Boiler and Power House, Trinity Place, on acct.		4,575.00
Lot No. 3 Trinity Place		259,050.00
SUNDRIES.		
Letter-Box 1899, used	31.00	
Students' Notes charged off	365.00	
" deposits paid	100.00	
		496.00
Cash balance, Sept. 29, 1900		37,831.70
		$1,405,410.09

The following account exhibits the property held by the Institute, as per Treasurer's books, Sept. 29, 1900:

INVESTMENT OF THE W. B. ROGERS MEMORIAL FUND.

$30,000.00	Burlington & Mo. River R.R. 4s. .	1910	25,787.50
27,000.00	Kansas City Belt R.R. 6s.	1916	27,000.00
6,000.00	New York & New England R.R. 6s.	1905	6,000.00
3,800.00	Republican Valley R.R. 6s. . . .	1919	3,800.00
4,000.00	Cin., Ind., St. Louis & Chicago R.R. 6s.	1920	4,000.00
2,000.00	Kansas City, Fort Scott & Gulf R.R. 7s.	1908	2,000.00
1,000.00	Lincoln & Northwestern R.R. 7s. .	1910	1,000.00
1,000.00	Atchison & Nebraska R.R. 7s. . .	1908	1,000.00
35,000.00	Fort Street Union Depot 4½s. . . .	1941	34,825.00
24,000.00	Rome, Watertown & Ogdensburg R.R. 5s.	1922	24,000.00
37,500.00	Detroit, G. Rapids & Western R.R. 4s.	1946	37,500.00
25,000.00	Atchison, Top. & St. Fé R.R. 4s .	1995	24,470.00
7,000.00	Chesapeake & Ohio R.R. 5s . . .	1939	7,000.00
38,000.00	Chi. Junc. & Union Stock Yards 5s.	1915	38,000.00
3,000.00	Chi., Mil. & St. Paul R.R. 7s. . .	1905	3,000.00
	Advances to Bond Premium account.		10,842.50
	Bonds		250,225.00

INVESTMENTS, GENERAL ACCOUNT.

$10,000.00	Bur. & Mo. River (Neb.) R.R. 6s., non-exempt	1918	10,000.00
2,000.00	Bur. & Mo. River (Neb.) R.R. 6s., exempt	1918	2,000.00
5,000.00	Chicago, Burlington & Quincy R.R. 4s.	1922	4,100.00
2,000.00	Kansas City, Fort Scott & Gulf R.R. 7s.	1908	2,000.00
3,000.00	Hannibal & St. Joseph R.R. 6s. . .	1911	3,000.00
6,000.00	West End Street Ry. 5s	1902	6,000.00
35,000.00	Fitchburg R.R. 5s.	1903	35,000.00
65,000.00	Boston & Maine R.R. 4½s.	1944	65,000.00
26,000.00	Am. Dock & Improvement Co. 5s. .	1921	26,000.00
3,000.00	Illinois Central R.R. 4s.	1951	3,000.00
26,000.00	New York & New England R.R. 6s.	1905	26,000.00
8,000.00	Chi. Junc. & Union Stock Yards 5s .	1915	8,000.00
5,000.00	Dominion Coal Co. 1st. 6s. . . .	1913	5,000.00
2,000.00	New England Tel. & Tel. Co. 6s. .	1907	2,000.00
2,000.00	New York & New England R.R. 7s.,	1905	2,000.00
100,000.00	West End Street Ry. 4s	1917	100,000.00
50,000.00	Utah & Northern R.R. 1st. 7s. . .	1908	50,000.00
90,000.00	Walter Baker Co. Ltd. 4½s . . .	1903	90,000.00
50,000.00	Chi. Terminal & Transfer Co. 1st 4s.	1947	47,507.50
120,000 00	Illinois Steel Co., non-conv. 5s . .	1913	119,586.25
43,000.00	Chesapeake & Ohio R.R. 5s . . .	1939	43,000.00
50,000.00	Chi. Junc. & Union S. Yards inc. 5s.	1907	50,000.00
50,000.00	Long Island R.R. 4s.	1949	46,637.50
7,000.00	K.C., Clinton & Springfield R.R. 5s.	1925	6,289.21
8,500.00	K. C., Mem. & Birmingham R.R. 4s.	1934	8,287.50
13,000.00	K. C., St. Jo. & Council Bluffs R.R. 7s.	1907	13,000.00
50,000.00	Kansas City Stock Yards 5s. . . .	1910	50,000.00
25,000.00	Atchison, Top. & St. Fé R.R. 4s. .	1995	25,000.00
50,000.00	Rio Grande & Western R.R. 4s. .	1939	49,180.00
50,000.00	Oregon R.R. & Navigation Co. 4s. .	1946	50,000.00
50,000.00	Union Pacific R.R. 4s.	1947	50,000.00
100,000.00	Chic. & West Michigan R.R. 5s. .	1921	100,000.00
100,000.00	American Tel. & Tel. Co. 4s. . .	1929	99,875.00
50,000.00	New England Tel. & Tel. Co. 4s. .	1930	50,000.00
50,000 00	Chi. Junc. & Union Stock Yards 4s.	1940	49,250.00
	Advances to Bond Premium account,		38,777.25
	Bonds		1,335,490.21
	Amount carried up		$1,585,715.21

Amount brought up $1,585,715.21

STOCKS.

SHARES.					
172	Boston & Albany R.R.	par	100	34,456.50	
50	Chi., Milwaukee & St. Paul R.R. Pf.	"	100	7,000.00	
12	Cocheco Manufacturing Co.	"	500	6,000.00	
56	Hamilton Woollen Co.	"	100	5,390.00	
31	Great Falls Manufacturing Co.	"	100	3,472.00	
2	Dwight Manufacturing Co.	"	500	1,600.00	
17	Pepperell Manufacturing Co.	"	100	2,789.50	
10	Lowell Bleachery	"	100	975.00	
27	Essex Co.	"	50	3,780.00	
55	Old Boston National Bank	"	100	5,510.50	
15	Merchants' National Bank	"	100	2,220.00	
25	New England National Bank	"	100	3,875.00	
25	Atlantic National Bank	"	100	2,875.00	
25	National Bank of the Republic	"	100	3,625.00	
40	The Molsons Bank, Montreal	"	50	2,930.00	
37	Nat. Mechanics Bank, Baltimore	"	10	706.70	
64	Boston Real Estate Trust	"	1000	68,909.64	
1	Boston Ground Rent Trust	"	1000	900.00	
					157,014.84

INVESTMENT OF THE JOY SCHOLARSHIP FUND.

Massachusetts Hospital Life Insurance Co. .	5,000.00	
Deposits in Savings Banks	4,123.70	
		9,123.70

INVESTMENT SWETT SCHOLARSHIP FUND.

Massachusetts Hospital Life Insurance Co.	10,000.00
Amount carried up	$1,761,853.75

Amount brought up			1,761,853.75
REAL ESTATE.			
Rogers Building		200,000.00	
Walker "		150,000.00	
Land on Garrison Street	50,840.00		
Workshops " "	30,000.00		
		80,840.00	
Land on Trinity Place	76,315.69		
Engineering B'ld'g A, Trinity Place,	90,000.00		
		166,315.69	
Gymnasium Building		7,967.85	
Engineering Building B		57,857.10	
Lot No. 2, Trinity Place		137,241.60	
Lot No. 3, Trinity Place		259,050.00	
Henry L. Pierce Building, Trinity Place		154,297.05	
Boiler and Power House, Trinity Place		26,916.74	
Clarendon St. Land and Building		142,762.94	
House No. 34 Commonwealth Ave.		30,000.00	
Real Estate, Massachusetts Ave., Cambridge		16,154.38	
			1,429,403.35
Equipment, Engineering Building		16,555.24	
" Workshops		20,628.56	
			37,183.80
SUNDRIES.			
Notes Receivable		62,000.00	
Boston Art Students' Association		10,333.32	
Students' Notes		835.50	
Cash Balance, Sept. 29, 1900		37,831.70	
			111,000.52
			$3,339,441.42

The foregoing property represents the following Funds and Balances, and is answerable for the same.

The income of the following is used for the general purposes of the Institute:

William Barton Rogers Memorial Fund	250,225.00	
Richard Perkins Fund	50,000.00	
George Bucknam Dorr Fund	49,573.47	
Martha Ann Edwards "	30,000.00	
Nathaniel C. Nash "	10,000.00	
Sidney Bartlett "	10,000.00	
Robert E. Rogers "	7,680.77	
Albion K. P. Welch "	5,000.00	
Stanton Blake "	5,000.00	
McGregor "	2,500.00	
Katharine B. Lowell "	5,000.00	
Samuel E. Sawyer "	4,610.87	
John W. and Belinda Randall Fund	83,452.36	
James Fund	163,654.21	
		676,696.68
Amount carried up		$676,696.68

Amount brought up		676,696.68
The income of the following is used towards paying salaries:		
Nathaniel Thayer, for Professorship of Physics	25,000.00	
Jas. Hayward, for Professorship of Engineering	18,800.00	
William P. Mason " " Geology	18,800.00	
Henry B. Rogers, for General Salaries . . .	25,000.00	
George A. Gardner, " " . . .	20,000.00	
		107,600.00
SCHOLARSHIP TRUSTS.		
Richard Perkins Fund	53,238.21	
James Savage Fund	13,825.69	
Susan H. Swett Fund	10,182.95	
William Barton Rogers Fund	10,640.62	
Joy Fund	9,123.70	
Elisha Thatcher Loring Fund	5,342.57	
Charles Lewis Flint Fund	5,264.09	
Thomas Sherwin Fund	5,000.00	
Farnsworth Fund	5,000.00	
James H. Mirrlees Fund	2,815.67	
William F. Huntington Fund	5,216.66	
T. Sterry Hunt Fund	3,225.32	
Elisha Atkins Fund	5,000.00	
Nichols Fund	5,000.00	
Ann White Vose Fund	60,755.89	
Ann White Dickinson Fund	40,618.19	
Dalton Grad. Chem. Fund	5,983.21	
Willard B. Perkins Fund	6,576.13	
		252,808.90
OTHER TRUSTS.		
Charlotte Billings Richardson Industrial Chemistry Fund . .		37,378.78
Susan Upham Fund		1,247.64
Susan E. Dorr Fund		9,526.92
William Hall Kerr Library Fund		2,000.00
Charles Lewis Flint Library Fund		5,000.00
Rotch Architectural Library Fund		5,000.00
Rotch Architectural Fund		25,000.00
Rotch Prize Fund		5,200.00
Rotch "Special" Prize Fund		5,200.00
Edward Austin Fund		341,215.64
Teachers' Fund		101,000.00
Letter-box Fund, balance		51.12
MISCELLANEOUS.		
Notes Payable	20,000.00	
Students' Deposits	200.00	
John Foster Legacy, 1893	10,000.00	
Henry L. Pierce Legacy, 1893	795,000.00	
John W. Carter Legacy, 1893	6,250.00	
Robert C. Billings Legacy	92,500.00	
M. I. T. Stock Account	240,515.74	
		1,764,465.74
		$3,233,441.42

Comparative Statement of Funds, etc.

	Sept. 30, 1899.	Sept. 29, 1900.
Trusts for general purposes	651,090.11	676,696.68
" " Salaries	107,600.00	107,600.00
" " Scholarships	252,025,16	252,808.90
" " Library	7,000.00	7,000.00
Charlotte B. Richardson Ind. Chem. Fund	37,378.78	37,378.78
Susan Upham Fund	1,295.81	1,297.64
Susan E. Dorr Fund	7,138.60	9,526.92
Rotch Architectural Library Fund	5,000.00	5,000.00
Rotch Architectural Fund	25,000.00	25,000.00
Rotch Prize Fund	5,200.00	5,200.00
Rotch "Special" Prize Fund	5,200.00	5,200.00
John Foster Legacy	10,000.00	10,000.00
Henry L. Pierce Legacy	780,000.00	795,000.00
John W. Carter "	6,250.00	6,250.00
Robert C. Billings "		92,500.00
Edward Austin Fund	340,000.00	341,215.64
Teachers' Fund	50,000.00	101,000.00
Letter-box Fund	82.12	51.12
Students' Deposits	300.00	200.00
Notes Payable	20,000.00	20,000.00
M. I. T. Stock Account	809,027.77	840,515.74
	$3,119,588.35	$3,339,441.42
Increase,		
Consisting of:		
Bequests for Special Purposes, etc. (See page 58)	55,389.53	
Gifts and Bequests for General Purposes. (See page 58)	133,106.57	
Net gain on Securities sold	40,446.51	
		228,942.61
Less Funds of 1899, used	31.00	
" Students' Deposits paid	100.00	
" Students' Notes charged off	365.00	
" Expenses more than Income	8,593.54	
		9,089.54
		$219,853.07

INCOME FROM GENERAL INVESTMENTS, AND APPLICATION THEREOF.

Applied to Salaries	4,304.00	From Dividends, Bank Stocks	1,108.35
" " Scholarships	8,175.00	" State Tax returned on Bank Stocks	251.85
" " " James Savage Fund	400.00	" Bonds	39,696.13
" " Charlotte B. Richardson Fund	1,495.15	" Dividends, Railroad Stocks	3,995.18
" " Teachers' Fund	2,000.00	" " Coal and Gas Stocks	786.54
" " Edward Austin Fund	13,600.00	" " Manufacturing Stocks	1,872.75
" " Rotch Prize Funds	400.00	" Telephone Stocks	573 02
" " Rotch Architectural Fund	1,000.00	" Real Estate Stocks	2.915.00
" " Library	480.00		
" " General Purposes	14,876.18		
" " Increase of Funds	1,112.34		
" " Advances to Bond Premiums	3,356.15		
	$51,198.82		$51,198.82

INCOME FROM WILLIAM BARTON ROGERS MEMORIAL FUND, AND APPLICATION THEREOF.

Paid Massachusetts Institute of Technology	10,900.48	Received Income from Railroad Bonds	11,613.00
Credited to Advances Bond Premiums	712.52		
	$11,613.00		$11,613.00

DETAILS OF SOME ITEMS IN TREASURER'S CASH ACCOUNT.

Rents.

Huntington Hall, for Lowell Lectures		3,500.00	
Lowell School of Design		1,800.00	
Land and Building, Clarendon St., on account		5,000.00	
34 Commonwealth Avenue	1,659.75		
Less Annuity under Will,	1,000.00		
" Tax, etc.	411.58		
		1,411.58	
		248.17	
Use of Rooms and Gymnasium		2,071.60	
		12,619.77	
Less Tax and Repairs, Cambridge, net		44.67	
			12,575.10

Department Supplies.

Chemistry	11,246.60	
Physics	6,624.20	
Mining	5,685.80	
Civil Engineering	2,963.52	
Mechanical Engineering	2,757.03	
Workshops	2,436.72	
Architecture	2,162.14	
Periodicals	1,912.34	
English	1,337.14	
Biology	1,101.89	
Applied Mechanics	995.48	
Naval Architecture	844.63	
Geology	843.19	
Modern Languages	227.03	
Mathematics	224.58	
Military	90.29	
Drawing	34.97	
		41,487.55

Salaries.

Instruction	198,838.30	
Administration	23,350.65	
Labor	26,883.10	
		249,072.05

General Expenses.

Electrical Wiring, Lamps, etc.	3,666.56	
Postage	2,512.55	
Paving Trinity Place	1,645.32	
Stationery and Office Supplies	1,170.80	
Janitors' Supplies	1,168.69	
Diplomas and Commissions	608.28	
Sprinklers, General Fire Extinguisher Co.	604.00	
Entrance Examinations	603.46	
Heating and Ventilating Engineering Buildings A and B	600.00	
Washing	585.02	
Sundries	568.35	
Express	541.94	
Engine Room Supplies:		
Oil	161.47	
Sundries	88.64	
Waste	68.19	
	318.30	
Ice	279.12	
Furniture	271.22	
Window Shades	227.75	
Examination Books	212.50	
Books, Supplies, etc., for General Library	205.76	
Removing Ashes	163.50	
Gymnasium	160.80	
Graduation Exercises	151.75	
Deposit Vaults	150.00	
Telephone Service	101.15	
Street Watering	86.80	
Glass	72.67	
Lowell School of Design	31.11	
		16,707.40

Repairs.

Department Improvements:		
Chemistry	1,016.76	
Workshops	628.50	
Civil Engineering	461.51	
Physical	442.33	
Naval Architecture	374.85	
Architecture	296.98	
Mechanical Engineering	233.86	
Mining	177.62	
Geology	133.37	
Biology	77.98	
English	59.03	
Applied Mechanics	48.38	
Drawing	28.25	
Modern Languages	22.04	
Mathematics	3.75	
	4,005.21	
Walker Building	2,635.20	
Engineering Building	1,460.56	
Rogers Building	1,379.76	
Sundries	1,254.16	
Steam Fitting	700.00	
Pierce Building	566.97	
Boiler and Power House	281.83	
Gymnasium	122.31	
		12,406.00

BOSTON, December 7, 1900.

An examination of the accounts of the Treasurer of the MASSACHUSETTS INSTITUTE OF TECHNOLOGY for the year ending September 29, 1900, has been made by Mr. E. A. Stone, an accountant employed by this committee. We have also verified the evidences of personal property held by the Institute.

The report of Mr. Stone is hereto annexed.

JAMES P. TOLMAN,
WILLIAM L. PUTNAM, } *Members of the Auditing Committee.*

BOSTON, December 7, 1900.

To the Auditing Committee of the
Massachusetts Institute of Technology:

GENTLEMEN: I have carefully examined the accounts of the Treasurer for the year ending September 29, 1900, and find everything to be correct. Said examination included: (1) A verification of the sums received during the year from all sources, embracing the interest on all investments; the changes in the same; the interest from deposits in banks and trust companies; and the students' fees. (2) The verification of the list of students with the Secretary's record of the same. (3) The vouchers for all sums paid out, and also the weekly pay-roll. The bank balances are correct and the items of the Trial Balance agree with the Ledger Balances.

Very respectfully yours,

EDWIN A. STONE,
Accountant.

MASSACHUSETTS

INSTITUTE OF TECHNOLOGY

ANNUAL REPORT

OF THE

PRESIDENT AND TREASURER

DECEMBER 11, 1901

BOSTON
GEO. H. ELLIS CO., PRINTERS, 272 CONGRESS STREET
1902

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Members of the Corporation.

President.
HENRY S. PRITCHETT.

Secretary.
FRANCIS H. WILLIAMS.

Treasurer.
GEORGE WIGGLESWORTH.

JOHN D. RUNKLE.
WILLIAM ENDICOTT.
HOWARD A. CARSON.
CHARLES J. PAINE.
CHARLES FAIRCHILD.
DAVID R. WHITNEY.
ALEXANDER S. WHEELER.
JAMES P. TOLMAN.
HOWARD STOCKTON.
ELIOT C. CLARKE.
NATHANIEL THAYER.
CHARLES F. CHOATE.
HIRAM F. MILLS.
PERCIVAL LOWELL.
ARTHUR T. LYMAN.
CHARLES MERRIAM.
THORNTON K. LOTHROP
CHARLES C. JACKSON.
SAMUEL M. FELTON.
DESMOND FITZGERALD.
SAMUEL CABOT.
FRANCIS BLAKE.
CHARLES W. HUBBARD.
THOMAS L. LIVERMORE.
A. LAWRENCE ROTCH.
JOHN R. FREEMAN.
GEORGE A. GARDNER.
WILLIAM H. LINCOLN.
J. B. SEWALL.
CHARLES L. LOVERING.
A. LAWRENCE LOWELL.
JAMES P. MUNROE.
WILLIAM L. PUTNAM.
CHARLES G. WELD.
EBEN S. DRAPER.
ROBERT S. PEABODY.
ELIHU THOMSON.
ELLIOT C. LEE.
JAMES P. STEARNS.
LUCIUS TUTTLE.

On the Part of the Commonwealth.

HIS EXCELLENCY HON. W. MURRAY CRANE, *Governor.*
HON. OLIVER W. HOLMES, *Chief Justice of the Supreme Court.*
HON. FRANK A. HILL, *Secretary of the Board of Education.*

Committees of the Corporation.

Executive Committee.

HENRY S. PRITCHETT.
GEORGE WIGGLESWORTH. } *Ex Officiis.*

HOWARD STOCKTON. THOMAS L. LIVERMORE.
FRANCIS H. WILLIAMS. A. LAWRENCE LOWELL.
ALEXANDER S. WHEELER.

Finance Committee.

WILLIAM ENDICOTT. NATHANIEL THAYER.
DAVID R. WHITNEY. CHARLES F. CHOATE.
CHARLES C. JACKSON. JAMES P. STEARNS.

Committee on the Society of Arts.

HOWARD A. CARSON. GEORGE A. GARDNER.
HIRAM F. MILLS.

Auditing Committee.

CHARLES C. JACKSON. JAMES P. TOLMAN.
WILLIAM L. PUTNAM.

Committee on Nominations.

THORNTON K. LOTHROP. GEORGE A. GARDNER.
DAVID R. WHITNEY. HOWARD A. CARSON.
FRANCIS H. WILLIAMS.

Trustees of the Museum of Fine Arts.

HENRY S. PRITCHETT. A. LAWRENCE ROTCH.
FRANCIS BLAKE.

Visiting Committees.

Department of Civil Engineering.

HOWARD A. CARSON.
CHARLES F. CHOATE.
ELIOT C. CLARKE.
DESMOND FITZGERALD.
JOHN R. FREEMAN.
LUCIUS TUTTLE.

Departments of Mechanical Engineering and Applied Mechanics.

HIRAM F. MILLS.
FRANCIS BLAKE.
JAMES P. TOLMAN.
EBEN S. DRAPER.
ELLIOT C. LEE.

Departments of Mining and Geology.

THOMAS L. LIVERMORE.
CHARLES FAIRCHILD.
JAMES P. TOLMAN.
CHARLES L. LOVERING.
JAMES P. STEARNS.

Department of Architecture.

THORNTON K. LOTHROP.
ELIOT C. CLARKE.
JOHN R. FREEMAN.
A. LAWRENCE ROTCH.
ROBERT S. PEABODY.

Department of Physics and Electrical Engineering.

FRANCIS BLAKE.
CHARLES W. HUBBARD.
A. LAWRENCE ROTCH.
ELIHU THOMSON.

Departments of Literature, History, and Political Economy.

FRANK A. HILL.
J. B. SEWALL.
CHARLES C. JACKSON.
A. LAWRENCE LOWELL.
JAMES P. MUNROE.

Department of Modern Languages.

J. B. SEWALL.
FRANK A. HILL.
THORNTON K. LOTHROP.

Department of Mathematics.

PERCIVAL LOWELL.
HOWARD STOCKTON.
WILLIAM L. PUTNAM.
CHARLES F. CHOATE.

Departments of Chemistry and Biology.

SAMUEL CABOT.
FRANCIS BLAKE.
ELIHU THOMSON.
DESMOND FITZGERALD.

Department of Chemical Engineering.

ARTHUR T. LYMAN.
HIRAM F. MILLS.
SAMUEL CABOT.
CHARLES W. HUBBARD.
ELLIOT C. LEE.

Department of Naval Architecture.

CHARLES J. PAINE.
HOWARD STOCKTON.
WILLIAM H. LINCOLN.
CHARLES G. WELD.

PRESIDENT'S REPORT.

To the Members of the Corporation:

In the report which follows I have endeavored to call to your attention the more interesting events in the progress of the Institute during the past year. This account, though a brief one, will make evident the fact that real progress is making. Not only has the attention of administrative officers and of the Faculty of the Institute been given to the task of promoting additional means of instruction, but the methods of instruction and the subjects taught are being inquired into as well. It is a useful experience for an institution of learning, as it is for an individual, to pause now and then, in order to examine its own work and to ascertain whether or not the best results attainable are being reached. Some such general inquiry is being made at this time by the Faculty and instructing staff; and while out of this discussion, perhaps, no sudden change is likely to come, it is possible that a better perspective of the work itself and of the relations of instructors and students to that work may result.

In this examination it has not been forgotten that the Institute aims to educate its students as well as to train them, and that, to be a successful engineer in the best sense, a man needs to be educated as well as trained. President Rogers had clearly in mind this dual purpose of the Institute,—education and training. In the earlier catalogues he stated its aims in the following words:—

"The course is so selected and arranged as to offer a liberal and practical education in preparation for active pursuits, as well as a thorough training for the professions

of Civil and Mechanical Engineering, etc. It is intended to secure to every student, whatever his special course of study, a liberal mental development and general culture, as well as the more strictly technical education which may be his chief object."

More than thirty years have gone by since those words were written, but the ideal there set forth is that which the Institute stands for to-day; and I should be glad to have the members of the Corporation know that, notwithstanding the many demands which engineering makes upon institutions of learning, time and thought are being given so to adapt our instruction to these ever-increasing needs as not to lose sight of the Institute's duty to educate as well as to train.

Any such internal examination of the working of the Institute brings to light urgent needs, and shows opportunities for wider usefulness; but there are two plans already definitely set on foot which mean so much to the success of the work itself, and which are so absolutely necessary for the present wants of the Institute, that I ask your immediate consideration of them, and, through you, the consideration and generous help of those who are interested in the education of earnest young men, whether they be residents of this city or region or not. The Institute of Technology is not a local institution. It has served, and will continue to serve, the interests of the entire country.

The first plan to which I refer is one for enabling the Institute not only to keep its facilities for instruction abreast of the modern demands in such subjects as physics, electricity, chemistry, and the like, but to keep up its standards of instruction in the face of the increasing demands created by the large accession to its numbers. Two years ago there were less than 1,200 students in the Institute; to-day there are more than 1,400. In the present first-year class there are 439 students. The increase in numbers of the last two years would in itself constitute a good-sized technical school.

These students are drawn in large measure from those classes which are welcomed most gladly. A number are graduate students, a still larger proportion come from the West and South, while a considerable number come from abroad. Nevertheless, when one reflects that each regular student costs the Institute about $100 more than he pays, one realizes that this growth, gratifying as it is in one way, imposes upon us a constantly heavier burden, and demands constantly increasing resources. Should each former student return to the Institute the difference between his actual payment and the cost of his education, the sum would prove an ample endowment for the present.

Not only is it true that increasing numbers mean increasing cost, but we have already reached the limit of our buildings in matters of instruction. For instance, instruction in chemistry, physics, and in electrical engineering are given in the Walker Building, in addition to certain instruction in modern lauguages. At the present time there are being instructed in this building 684 men in chemistry, 848 men in physics, 89 men in electrical engineering, and a large number in modern languages. Even these numbers represent those left after a careful culling out of students who under ordinary conditions would be allowed to take these subjects and the cutting down of classes to the smallest possible numbers. In addition some relief has been afforded by the use of rooms, though ill-suited to the purpose, in an adjoining street; but at this moment every possible space is being utilized for every moment of the day.

For next year, when the present first-year class goes into the second year, and is followed by a similar class, I do not know how we shall be able to provide for them. The problem is one which is of so great importance that I cannot overstate its significance and the necessity of an immediate solution.

Foreseeing somewhat of this condition, the Executive Committee has recommended the erection on the Trinity Place ground of a building for electrical engineering, and

the equipment of that building with modern appliances for the teaching of that subject. But since the opening of the present term it is evident that even the removal of electrical engineering from the Walker Building would give scarcely momentary relief, and that, to deal with the problem effectively and to afford the provision for chemistry which is urgently demanded, it is necessary to move both physics and electrical engineering. Furthermore, additional investigation of the subject shows the great economy of keeping these departments in close contact.

To provide for the Department of Electrical Engineering alone would involve an expenditure for building and apparatus of about $275,000, while to erect a building capable of providing for both departments would cost about $350,000.

A most generous beginning has been made toward this new building by a subscription of $50,000 from the sons and daughters of our late colleague, Mr. Augustus Lowell, and an additional subscription of $10,000 from Mr. George A. Gardner, in all $60,000. I cannot but believe that, if the absolute need of the Institute were known, and if at the same time those who are interested in young men in America were aware of the opportunity afforded here for ministering to students from all parts of the United States, means would be provided without delay for meeting these immediate demands. The Institute of Technology has reason to be proud of what it has accomplished with modest financial resources. It would be an extraordinary condition of affairs if the response by the youth of the country to the instruction offered here should be so large that it should outstrip the facilities provided for that work.

Two courses seem open to us in meeting this problem. One is to cut down the number of students to the measure of our present working facilities by imposing such arbitrary conditions as may limit the number of those who can enter. The other way of meeting this problem is, while maintaining all proper standards of entrance requirements, and even

advancing these standards, to make the facilities for instruction so generous and so complete that the Institute of Technology may lead the world in the teaching of applied science, and that it may continue to draw to itself in yet larger numbers students from the whole country and the whole world.

I have found, now and again, some question as to the wisdom of opening without reserve our facilities to these students. Some ask, Why encourage students from Texas and from California, from England or from Australia, to come to the Institute of Technology? Why should Massachusetts supply the facilities for training those who may in the near future be using the skill thus gained in the service of her industrial rivals, domestic, or foreign?

Let me express the conviction that no institution of higher learning which undertakes to limit its ministry to its own section or to its own community is worthy of the highest devotion. And no man is worthy to direct such an institution who is willing to consider the problems of education from the sole standpoint of the upbuilding of the influence and power of the particular institution which he represents. College spirit and college devotion in the United States mean in too many instances devotion to the interests of a particular institution, and not devotion to the cause of education of the State, of the nation, and of the world. I believe profoundly that an institution which seeks to serve the purposes of the widest education and of the highest training best serves its own community when it serves best the citizens of the whole country and of the world. The attendance of students from abroad is the best barometer we have of our own alertness and our own fitness. And I am sure that, when the Institute of Technology ceases to serve as freely the student from abroad as the student from Massachusetts, when it ceases to attract to its lecture-rooms and to its laboratories the student from Texas and the Carolinas, from Washington and California, from England and Australia, from China and Japan, it will cease to serve efficiently the student from New England and the student from Massachusetts. After all, a

great institution of learning is like a great magnet. Its power grows in proportion as it attracts particles to it. Its power wanes when it ceases to carry its full load.

I earnestly commend to your attention the situation which I have just portrayed. I have endeavored to do my own duty in describing to you the situation as it exists; and I beg your assistance in bringing the facts which I have mentioned to the attention of those who have at heart the interests of Massachusetts, and of New England, and of the country.

The second enterprise already under way, to which I desire to call your attention, is the plan for the completion of what has been called the Walker Memorial Building. As you have already learned, $100,000 has been subscribed for this purpose by the past and present students of the Institute, of which $5,000 was the gift of the class of 1901 on its day of graduation. Never before, so far as I can ascertain, has a class of undergraduates given on their day of graduation, by united action of the entire class, $5,000 to their Alma Mater. When one considers that the alumni of the Institute are for the most part young men, their contribution of $100,000 is an unusual exhibition of loyalty. It is important, to my thinking, to meet this evidence of their devotion at least half-way, and to raise the remaining amount necessary to complete the building at the earliest possible moment.

The building as it is planned contemplates not simply a gymnasium, not simply a building for physical culture,— though it will serve both these purposes,— but it is to afford as well a place which shall be the social center of student life. No need is more urgently felt amongst the students of the Institute than that of closer contact with each other and with men from outside. The very fact that students do not live in dormitories, but in isolated houses, gives less opportunity to cultivate the social side. A graduate of the Institute is far more likely to fail by reason of lack of ability to deal with men than by lack of technical knowledge. He needs strengthening on the side of relationship

with other men rather than strengthening in a particular branch of a particular part of engineering.

Looked at from this standpoint, the Walker Memorial Building is to occupy to students a function no less important than that of any other means for instruction and training which the Institute supplies; and the need for the prompt and speedy completion of this building is felt no less keenly than that for increased facilities in technical instruction.

To make of this building one which shall accomplish the end in view, $100,000 is necessary in addition to that already subscribed by the past and present students. A member of our Corporation has made a generous start toward this by a subscription of $10,000, in addition to which other contributions have been received, bringing the total up to $25,000.

Should not every member of the Corporation take an active personal share in establishing a memorial to President Walker, who gave the best years of his life to the service of the Institute?

I beg to urge upon you, and through you upon those who are interested in young men and who believe that students are to be educated not only as engineers but as men, the need for a prompt completion of this subscription.

These two plans of the Institute, already begun, call for your careful, earnest, and, most of all, your immediate attention; and I commend them to you as enterprises which may well appeal to every citizen.

NEW MEMBERS OF THE CORPORATION.

Since my last report three members have been added to your body by the election of Mr. Elliot C. Lee, Mr. James P. Stearns, and Mr. Lucius Tuttle. They have been assigned to the following committees: Mr. Lee to the Visiting Committee on the Departments of Mechanical Engineering and Applied Mechanics and that of Chemical Engineering; Mr.

Stearns to the Visiting Committee on the Department of Civil Engineering and to the Committee on Finance; Mr. Tuttle to the Committee on the Department of Civil Engineering.

CHANGES OF FACULTY AND INSTRUCTING STAFF.

Professor Wells, who was granted leave of absence last year, has returned with improved health, and is taking his share of the work of the Department of Mathematics.

Professor Talbot has been appointed head of the Chemical Department. Professor Talbot graduated in the Department of Chemistry in 1885, and, except for two years of university study in Germany, has been continuously connected with the Institute, holding a full professorship since 1898. For a considerable period he has exercised an important share of the responsibilities of the head of a department; and the present action of the Executive Committee in giving him the formal appointment will, without involving any change of policy, conduce to more effective organization and conduct of the work of this important department and of our courses in Chemistry and Chemical Engineering.

Professor Homer, of the Department of Architecture, has accepted an appointment as Director of the Rhode Island School of Design at Providence, fortunately, however, continuing his lectures on the history of architecture to our students. Professor Homer graduated in the Department of Architecture in 1885, and has been connected with it in successive grades since 1887. In recent years he has also engaged in professional practice. Professor Homer carries with him to his new work the cordial esteem of his colleagues.

Professors Dippold, Currier, and Ripley have been advanced to professorships in their respective departments. Professor Dippold was appointed instructor in modern languages in 1886. He is a native of Frankfort on the Main, where he completed his course at the Gymnasium. After

attending lectures at Heidelberg, he came to America, and first occupied a position as tutor in German in Harvard University, 1870–73. After this he was instructor in French and Anglo-Saxon in Boston University, 1874–83, where he took the degree of Doctor of Philosophy. He was subsequently instructor in German in Wellesley College, and in 1883 at the Johns Hopkins University.

Professor Currier was appointed instructor in history in 1891. He graduated in 1887 from Harvard University, and in 1888 received the degree of Master of Arts from that institution. After further study at Harvard, chiefly in constitutional history, he spent a year at Berlin with Professors Gneist, Brummer, and others, and then a year at Paris in the École Libre des Sciences Politiques. In 1893 he assumed charge of the instruction in history, and has shown excellent capacity in the work.

Professor Ripley's appointment as associate professor was mentioned in my report of last year, with a brief statement of his previous record. I regret to have to add that Professor Ripley's connection with the Institute is to be terminated at the end of the present year by his resignation to accept a professorship in Harvard University, where he has been giving lectures during the present year. Professor Ripley's nine years of service at the Institute have been highly successful and productive. He enters a wider field of usefulness with our best wishes and high expectations.

Assistant Professors Puffer and Lawrence have been promoted to associate professorships in the Departments of Electrical Engineering and Architecture respectively. Professor Puffer graduated in Mining Engineering in 1884, and has been connected with the Departments of Physics and Electrical Engineering continuously since that time, becoming a member of the Faculty in 1893. He has had the main responsibility under Professor Cross for the conduct of the laboratory work in Electrical Engineering, and has this fall made an extended tour among European laboratories, with a view to securing the best attainable results in the

planning of the new building which has been authorized for that department.

Professor Lawrence has been successively instructor and assistant professor of architecture since his graduation in 1892. He has had the chief share in the development of our present engineering option in architecture,—a line of work of increasing interest and importance.

Among new Faculty appointments is that of Captain William Hovgaard, of the Royal Danish Navy, who becomes Professor of Naval Design, and will have charge of warship-design and of cognote courses of lectures. The work of the department has increased in scope and importance, particularly with the advent of the naval cadets this year. The special course planned for them has received the cordial approbation of the United States Department of the Navy.

The following instructors of last year were appointed assistant professors in the spring: Messrs. Derr, Wendell, and Norton, of the Department of Physics; Messrs. Whitney, Thorp, Fay, and Norris, in the Department of Chemistry; Messrs. Fuller, Johnston, and Park, in the Department of Mechanical Engineering. Of these, Messrs. Derr and Thorp graduated in 1889; Dr. Whitney, in 1890; Mr. Derr, Dr. Wendell, Mr. Fuller, Mr. Johnston, and Mr. Park, in 1892; Mr. Norton, in 1893. Messrs. Wendell, Whitney, and Thorp have during leave of absence taken the degree of Doctor of Philosophy in the University of Leipsic. Messrs. Fay and Norris have taken the same degree at Johns Hopkins University. All of these gentlemen have done important and responsible work as instructors, and their accession strengthens the Faculty. Messrs. Charles B. Breed, William S. Newell, Harrison W. Smith, Maurice de Kay Thompson, and Charles-Edward A. Winslow, assistants of last year, have been promoted to the rank of instructors.

Newly appointed instructors are: William J. Drisko, in the Department of Physics; Reginald R. Goodell, in the Department of Modern Languages; Charles E. Locke, in Mining Engineering and Metallurgy; and Henry L. Seaver, in English.

Mr. Drisko graduated from the Department of Physics in 1895, and was connected with the department, first as assistant, then as instructor, till 1899, when he resigned to become Professor of Physics in Colby College. Mr. Goodell graduated from Bowdoin College in 1893, and took the degree of Master of Arts in 1895. His time has since been given to teaching and to advanced study abroad and at Johns Hopkins University. Mr. Locke graduated in the Department of Mining Engineering in 1896, and has since that time been engaged in professional practice and in private work for Professor Richards. Mr. Seaver is a graduate of Harvard University, where he has also had successful experience in the teaching of English.

Instructors and assistants who have terminated their connection with the Institute are Messrs. W. L. Smith, N. E. Seavey, and C. H. Hapgood, of the Department of Physics and Electrical Engineering; C. H. L. N. Bernard, of the Department of Modern Languages; H. E. Andrews, in English; A. S. Merrill and F. R. Swift, in Mechanical Engineering; J. W. Brown and J. H. Walton, Jr., in Chemistry; H. C. Plummer and W. L. Stevens, in Mining Engineering; G. E. Russell and A. B. White, in Civil Engineering; and F. Cushman, Jr., in Mechanic Arts.

The following assistants have been appointed: John P. Sanborn, Jr., and Robert G. Valentine, in English; Edward P. Beckwith and Arthur C. Davis, in Chemistry; Frederick G. Clapp, in Geology; Francis B. Driscoll and Samuel L. Wonson, in Civil Engineering; Henry L. Kehl and Harry R. White, in Mechanical Engineering; John Boyle, Jr., William W. Garrett, and Frederic H. Sexton, in Mining Engineering; Warren I. Bickford, Francis E. Cady, Harry E. Dart, Clinton M. Dearden, Frederic W. Freeman, Herbert H. Kennedy, and George L. R. Mitchell, in Physics; James C. Woodsome, in Mechanical Drawing; and Charles E. Littlefield and Eugene S. Foljambe, in Mechanic Arts.

SCHOLARSHIPS.

The Executive Committee assigned for the present year $5,000 from the Austin Fund for undergraduate scholarships. The number of applicants for Institute scholarships up to the present time has been 263, while 123 submitted applications for the 40 State scholarships. 62 of these made applications in both places, leaving the total number of applicants considered by the Faculty and the State Board of Education 324. Of these, 28 have received scholarships to the amount of full tuition; 157 others have received smaller amounts, averaging somewhat more than $100 each. In accordance with the act of the Legislature authorizing division of State scholarships, 21 of the 40 were so divided, thus increasing the number of recipients to 61.

GRADUATE SCHOLARSHIPS.

The graduate scholars of the current year are Messrs. Arthur H. Birks, S.B., Robert R. Goodrich, S.B., Louis R. Henrich, S.B., William G. Holford, S.B., George T. Hyde, S.B., Ellis F. Lawrence, S.B., Julius E. Ober, S.B., Langdon Pearse, S.B., Francis W. Puckey, S.B., and Bart E. Schlesinger, S.B., all of the class of 1901; Walter R. Kattelle, S.B., of the class of 1900, William C. Phalen, S.B., of the class of 1899, Henry A. Swanton, S.B., of the class of 1894, and John H. Morse, B.A., of the University of Nebraska. Of these students, five are working in the Department of Architecture, two in Chemistry, two in Civil Engineering, one in Electrical Engineering, one in Geology, and one in Naval Architecture, while one is taking special work in Drawing and Mechanic Arts.

FELLOWSHIPS.

The Savage Fellowship has been awarded to Mr. M. de K. Thompson of the class of 1898. Mr. Thompson, previously

an assistant in the Rogers Laboratory, has been appointed instructor in electro-chemistry, and is spending the winter in study at the Polytechnicum at Zürich.

The income from the Austin Fund has enabled us to continue the following appointments. Mr. Arthur A. Blanchard, of the class of 1898, and for two years assistant in theoretical chemistry; Mr. Louis P. Chapin, a graduate of the University of Minnesota and since 1897 assistant in general chemistry; and Mr. Miles S. Sherrill, of the class of 1899, assistant in analytical chemistry, are taking courses at the University of Leipsic. Mr. Joseph G. Coffin, of the class of 1898, for two years assistant in physics, is a graduate student at Clark University. In addition two new appointments have been made this year: that of Mr. John W. Brown, assistant last year in analytical chemistry; and that of Mr. James H. Walton, assistant in general chemistry, who are studying for the degree of Doctor of Philosophy at the University of Heidelberg.

STUDENT ADVISERS AND STUDENT LIFE.

During the past year, efforts have been made in one direction or another to assist students in their choice of studies and to give them such advice as should be helpful to them in their work and in their life. The members of the first-year class have been for several years assigned to members of the instructing staff for this purpose, and instructors so designated have been termed Advisers. This plan, while it has been productive of good, has not resulted in all that was expected. At the beginning of the present year the Advisers themselves were called together, and were invited to meet the students of the incoming class at the beginning of the term. This meeting resulted in the establishment of useful relations between students and Advisers; and, with some modification, it is hoped that the plan may have still further application next year.

One of the problems which confronts the young man

coming to the Institute, and which has not always been satisfactorily solved, has been that of securing comfortable quarters. A building is now being erected on Huntington Avenue which is to serve the purpose of a dormitory, or perhaps more nearly the purpose of the English University House. It will accommodate about one hundred and seventy-five men in a most comfortable fashion, and they will be provided with meals as well as rooms in the building. While not the property of the Institute, it will be conducted with the co-operation of its officers.

TECHNOLOGY FIELD DAY.

The action of the undergraduates of the Institute concerning athletics, taken during the past year, has been of a most satisfactory character. The members of the Corporation will recall the sad circumstances attending the celebration of what was known as the "Cane Rush" in November, 1900. Since that time, in a most frank and manly way, the undergraduates have taken up the question of changing this old-time celebration into some form of athletic contest which should be satisfactory and yet furnish a test of strength between the Sophomore and Freshman Classes. Incidentally, the entire question of athletics was discussed, and considerable thought was given to the forms of exercise consistent with the work of students of the Institute. As a result of the discussion, the student body voted to withdraw for the present from inter-college football, and to confine their participation in this game to the class contest. They voted, in addition, to substitute for the former "Cane Rush" a series of athletic contests, to be held on a day chosen for that purpose, and to be known as "Technology Field Day." These contests were successfully held, last November, in the presence of a large number of friends and graduates of the Institute; and the occasion proved not only a most interesting one from the standpoint of the events themselves, but also a most satisfactory one as marking a sensible solution of such a question by students.

ENTRANCE REQUIREMENTS AND EXAMINATIONS ABROAD.

The past year has seen a wide discussion among colleges in the matter of entrance requirements. The question is one which is of great importance to the Institute; and I have to report that the Faculty have adopted a resolution by which, after 1903, the definition of entrance requirements will be so changed as to require an applicant for admission to have done preliminary work in both German and French.

Examinations for admission have been held during the past year in a number of places, particularly in the South and West, where previously we have held none. The Faculty has accepted examinations for admission conducted by the College Examination Board of the Middle States and Maryland. Entrance examinations were held also in London in June last, for the first time, for the convenience of such English applicants as might wish to take advantage of engineering educational facilities in America. The results have been satisfactory; and, while the examinations have resulted in the attendance of only a small number of students from England, they have fulfilled their main object in stimulating the discussion of questions which concern engineering instruction both here and abroad.

CLASS OF NAVAL CADETS.

An interesting addition to our student body has been brought about in the presence of the Naval Cadets of the United States now here for instruction in naval architecture. The Navy Department appoints, each year, two or three men as Naval Cadets; and, beginning with the present term, these men are to be educated in the Department of Naval Architecture of the Institute of Technology. At present three cadets are pursuing work here, to be followed from year to year by a similar number. A special course in

naval architecture has been arranged to meet the needs of these students.

GIFTS FOR THE PAST YEAR.

The following gifts, in addition to the subscriptions for the Walker Memorial Building and the new building for Electrical Engineering, which have already been announced, have been available for the present year.

The General Court of Massachusetts has by its vote continued its annual appropriation of $25,000 for ten years.

The bequest made some years ago by Mr. Henry Saltonstall, a friend we love to remember, has become available during the present year.

I have also the pleasure to acknowledge the gift of a Westinghouse air brake by the Westinghouse Company, and of a milling machine which has proved a most valuable contribution to the physics laboratory, and which was provided by the thoughtfulness of Mr. Francis Blake. In addition to these I have to acknowledge the gift of a number of specimens of ores from the Colorado Fuel and Iron Company, and the gift of the painting, "The Discovery of Aniline," by the Fallon heirs.

I desire at this time to acknowledge the gift of a number of prizes, instituted by Mr. Samuel Cabot for individual physical improvement, which have proved to be a great stimulus toward physical excellence.

A free bed, provided by the Massachusetts General Hospital for the benefit of any student at the Institute in need of such facilities, has proved one of the most welcome gifts which could come to the student body. It has already been occupied by a number of students, and is gratefully accepted as a recognition on the part of the authorities of the Hospital of the work done by the Faculty of the Institute.

SOCIETIES AND PUBLICATIONS.

The various societies connected with the Institute are accomplishing in their separate fields work of an important sort. The alumni societies in other parts of the country have in the past year taken a new interest in the Institute and its work; and many evidences of this have come to the instructing staff, not only in the Walker Memorial subscription, but in suggestions and inquiries regarding the work of the Institute. This spirit is one which it is desirable to foster in every way, and one which I hope to see increase as time goes on.

One of the agencies which has contributed in large measure has been the Technology Club, which has, during the past summer, taken a new house on Newbury Street, and which is filling a constantly increasing place in ministering to the social life of the students and alumni.

The *Quarterly* and the *Review* have continued during the past year to serve their purpose admirably, and to contribute to a knowledge of the work of the Institute.

The Institute was represented at the Yale Bicentennial Celebration by a committee of the Faculty consisting of the President and Professors Sedgwick and Porter. It was also represented at the Pan American Exposition by an exhibit designed to show the nature of the work accomplished at the Institute. At the request of the authorities of the Charleston Exposition this exhibit has been removed to that exposition without cost to the Institute, and will remain there until the close of the exposition.

ECLIPSE EXPEDITION.

An expedition made up largely of members of the instructing staff of the Institute, under the leadership of Professor Burton, was sent last May to observe the total eclipse of the sun in Sumatra. The observations and photographs which they obtained, and which are now being discussed, promise results of interest and value.

REPORTS OF DEPARTMENTS AND STATISTICS.

There is given in the following pages a summary of the reports of the heads of the various departments, together with statistical information prepared in the office of the Secretary concerning attendance, choice of studies, and similar matters. The information contained in these reports and tables is of the highest value, and I commend it to your careful inspection.

HENRY SMITH PRITCHETT,
President.

BOSTON, Dec. 11, 1901.

REPORTS FROM THE DEPARTMENTS.

Civil and Sanitary Engineering.

No changes have been made in the course of study in Civil or Sanitary Engineering during the past year, and no important changes in the staff of instruction.

The number of students in this department is increasing; and the drawing-rooms are reaching the limit of their capacity, particularly that occupied by the second-year students. The Engineering Library also is growing very rapidly, and will within a short time be so crowded that some additional room will be required. This will render necessary further changes in the arrangement of the rooms of the department; and, in making plans for any new buildings, provision should therefore be made for additional space for this department, adjoining the quarters which it now occupies.

The demand for graduates in civil engineering has steadily increased. Since May there have been received applications for over one hundred and twenty young men to fill civil engineering positions; while the class which graduated last June, although the largest ever sent out, numbered but forty. Of these applications, thirty-five were for structural work, forty-one for railroad work, twelve for teaching, twelve for hydraulic work, and twenty-three for miscellaneous engineering work. In addition to these, during the spring of 1901, previous to May 1, there were some fifty other applications.

In December, 1900, the Base Line Apparatus, which has been in use in the Summer Schools of the Civil Engineering Department for the past five years, was tested by the officers of the United States Coast and Geodetic Survey, not only at Washington, D.C., but also under the conditions of actual

practice at the Alice Base Line in southern Texas. The test was favorable to the Institute apparatus; and a report by Assistant John F. Hayford, C.E., has been published in the June number of the *Technology Quarterly*.

The party sent to Sumatra to observe the total solar eclipse of May 18, 1901, consisted of Professor A. E. Burton and Mr. George L. Hosmer of the Civil Engineering Department; Mr. Harrison W. Smith, instructor in the Department of Physics; and Mr. Gerard H. Matthes, a graduate in civil engineering of the class of 1895, at present Assistant Hydrographer of the United States Geological Survey. An appropriation of $2,000 was made from the Austin Fund for this expedition, all expenses beyond this amount being met by private contributions. Through the courtesy of the Superintendent of the United States Coast and Geodetic Survey the party was furnished with the half-second pendulum apparatus, by which determinations were made of the force of gravity at several points near the earth's equator. Professor E. C. Pickering, of the Harvard College Observatory, kindly loaned the expedition two Clarke lenses, ground especially for eclipse photography. The outfit, in addition to the above, consisted of an astronomical transit with micrometer and latitude level, three chronometers and a chronograph, an equatorially mounted telescope with five-inch objective, a magnetometer, and a dip circle. The party left New York February 24, and arrived at Padang, on the west coast of Sumatra, April 6. The Dutch government gave generous assistance to the expedition, and an excellent location for the observing station was obtained at Sawah Loento in the interior of the island. Here three buildings were constructed to shelter the different pieces of apparatus, and masonry piers were erected for the three large cameras. The day of the eclipse was not perfectly clear, but at the time of totality the conditions were such as to enable Mr. Smith to secure several fine photographs of the corona. The shadow bands were seen distinctly both before and after totality, but the photographic records

of these bands are not entirely satisfactory. Magnetic observations showed slight disturbances of the magnetic needle. Pendulum observations were made at Sumatra, at Singapore, and afterwards at Washington, D.C. The party returned by the way of China, Japan, and the Sandwich Islands. A full report of the work of the expedition will soon be published in the *Technology Quarterly*.

It is interesting to note the extent to which instructors and assistants are engaging in professional work during the summer vacations. Such work is encouraged in order that the young men may come in touch with practical men and practical methods. During the past summer seven members of the department were engaged in bridge design and in surveying of various sorts.

The fourteenth session of the Summer School of Civil Engineering was held at Machias, Me., where the school was held in 1896 and 1897. Twelve students were in attendance. The work was in charge of Professor Robbins and Mr. Sweet, assisted by Messrs. Driscoll, Pearse, and Wonson of the class of 1901. The topographical work consisted of an extension of the plane-table sheets and triangulation of four years ago. The hydraulic work consisted of both tube and meter measurements of the flow of the Machias River and of a canal supplying one of the mills.

Soundings were made at Howard Bay, some eleven miles from Machias, where a tide-gauge was set up and continuous readings were taken to determine the mean sea-level. The location of the tide-gauge was the same as that occupied by the United States Coast and Geodetic Survey several years ago, and the elevation was referred to the bench mark of that survey on an adjoining ledge.

Mechanical Engineering.

The present school year 1901–1902 is the second of the option in heating and ventilation, the first of the new course in naval architecture given to the Naval Cadets, the first

in which an option in machine design is given to Course X., and the first in which the new engineering options in Courses V. and VIII., as well as the advanced course for graduates of Courses V. and VI., go into operation. All of these involve additional work on the part of the Mechanical Engineering Department.

If the laboratory is to continue to hold the position that it has held in the past, certain additional apparatus must be obtained, both in view of the increasing number of students to be provided for and also to enable us to make investigations along certain new lines which are of great importance from an engineering point of view.

Probably the two most complete investigations made in connection with thesis work during 1900–1901 relate, the first to the flow of air through orifices and the second to the explosion of gases. The formulæ for the flow of air used at the present time are based on the experiments of Fliegner. These experiments were made with orifices under 10.0 millimetres in diameter, and with pressures not greater than 80 lbs., and constantly decreasing. The apparatus at the Institute is arranged so that orifices up to two inches in diameter, or 51.3 millimetres, can be tested under constant pressures up to 350 lbs. During the past year orifices from three-sixteenths through five-eighths of an inch have been tested. Experiments have been conducted also to determine the explosive force of mixtures of gas and air under initial compression. Very little work has been done in this line outside of the tests made at the Institute. The work is especially valuable in connection with the study of gas-engines.

Through the kindness of the officials of the various railroads, opportunity has been furnished for some years to conduct road tests of locomotives in connection with the thesis work of the students. During the present school year the series of such tests is exceptionally complete.

Mining Engineering and Metallurgy.

The importance of metallography, the microscopical study of the structure of metals, is being more and more recognized. Even the iron foundries are now using this means for controlling the quality of their materials, in order to produce even and reliable results. The course in this subject has been transferred from the Chemical to the Metallurgical Department, where it naturally belongs. Lectures and laboratory work in this line have been added to the curriculum for all regular students in the Course in Mining Engineering and Metallurgy, and advanced work is provided also for those who elect this subject for a thesis or wish to work upon it with the view to obtaining an advanced degree. This work is under the charge of Professors Hofman and Fay.

The instructing force has been increased from three assistants, as it was last year, to four assistants and an instructor. A further increase may be needed next year,

The Summer School of Metallurgy was held in New York, New Jersey, Pennsylvania, and Maryland. The party had a fine opportunity to see the smelting of zinc for the formation of oxide as well as the production of spelter at the works of the New Jersey Zinc Company. The study of the metallurgy of copper was taken up at the works of the Nichols Chemical Company, the Baltimore Copper Company, and the Guggenheim Smelting Company. Iron blast furnaces and the Bessemer process were studied with the Maryland Steel Company and the Pennsylvania Steel Company; open hearth steel manufacture, with the Pennsylvania Steel Company, the Pencoyd Iron Company, and the Midvale Steel Company; the crucible steel process, at the works of the Atha Steel Company; and lead and silver smelting, with the Guggenheim Smelting Company.

A graduate course in mining and metallurgy has this year been added for students who can afford to give an additional year to professional study. It enables the student to take

additional mechanical and electrical studies, and then leaves him, by means of two options, the choice between mining and metallurgical work.

Architecture.

The steadily increasing number of our graduates returning to the Institute for a year's study is perhaps the most gratifying thing connected with the Department of Architecture. This year there are eleven Institute graduates and one from Columbia University pursuing advanced courses, and five of them are candidates for the degree of Master of Science. The year is not only a breathing-space in which to become better acquainted with the culture which our library gives, but it is the opportunity for a fuller application of practical problems and for continued study in professional work. It is the true means of fostering work of a high grade.

The option in architectural engineering has well met an important demand, and its high standard is fully acknowledged by the exceptionally good positions found for its graduates. It is already beginning to attract students from other universities; and we have at present one advanced student in the option, a candidate for the Master's Degree.

The option in landscape architecture will complete its first four years next June. These years have fully proved that we have made no mistake in adding this option to our course. The facilities offered by the Institute, and the unusual opportunities for outdoor study in close proximity, leave nothing to be desired. Notwithstanding the entire lack of precedent of a well-defined course of study for the landscape architect, the results of the year show need of only slight changes in that laid down. These will be carefully considered and attended to.

The prosperity of the country made itself so strongly felt last summer in the demands from architects for draughtsmen's services that our Summer School was given up. The demand came for every one we could send, experienced or

otherwise; and we could not advise against so good an opportunity of early acquaintance with the routine of an architect's office.

Chemistry and Chemical Engineering.

Reference was made in the President's Report of last year to the arrangement of five series of optional studies within the chemical course. These options were offered to students of the second year at the beginning of the school year 1900–1901; and at that time three students selected Option 1, thirteen students Option 2, and two students Option 5, while of the present second-year class six have selected Option 1, seven Option 2, one Option 3, three Option 4, and one is undecided as yet between Options 2, 3, and 4. On account of the necessary delay in bringing these options to the notice of the students of the first of these classes, it is probable that the selection made by the present second-year class is more nearly typical of what may be expected in the future; but the number of students entering Option 1 will probably increase as the advantages of this option for students intending to devote themselves to technical chemistry after graduation become better known.

The optional studies of the fourth year of the Course in Chemical Engineering have been increased by the introduction of a course in machine design and a course treating of the general principles of chemistry.

Minor changes in individual courses of instruction include an improved system of note-book correction in the laboratory of inorganic chemistry, by which the work of an increased number of students is more efficiently inspected than formerly and with less delay to the student; an increase in the number of excursions in connection with the course in industrial chemistry; a modification of the laboratory work in the examination of foods to meet the demand for a knowledge of food adulterants; and the introduction of a special course in the testing of air for students in the heating and ventilation option of the Mechanical Engineering Course.

The laboratories of industrial chemistry have been enriched by two gifts,—a set of the *Zeitschrift für angewandte Chemie*, given by Mr. Samuel Cabot of our Corporation, and a Gates rock-crusher, presented by the Allis-Chalmers Company of Chicago, through Mr. Cabot. The *Zeitschrift* is a valuable addition to the small supplementary library of technical works which is being brought together for the immediate use of students in industrial chemistry in the Pierce Building. The rock-crusher is an equally valuable addition to the laboratory equipment.

The large increase in the entering class of this year has already crowded the laboratory of inorganic chemistry; and the number of students who will be entitled to working places in analytical chemistry next autumn, in the second, third, and fourth years, exceeds by about thirty-five or forty the number of desks which can be provided, with the present laboratory space. All can be accommodated next year if an additional laboratory can be equipped on the second floor, but a still larger number must be provided for in 1903–1904; and, if the entering class increases in size, further provision for inorganic chemistry, both lecture-room and laboratory space, will then be unconditionally necessary. Besides the increase of space demanded for the two branches of the department just mentioned, other laboratories are in need of enlargement; and it is becoming more and more essential for the well-being of the Chemical Department that members of its instructing force should have both space and time at their disposal to be devoted to research work, and that such work should be a recognized part of their duties. Several of the private laboratories which it is now possible to provide are inadequate in size; and throughout the department small laboratories for special lines of work, such as are found in all the best foreign laboratories, and the newer American laboratories, are much desired. Not less important is the development of research laboratories for advanced students upon a more liberal scale than is now possible, and the need of a room to be used as a

chemical museum, referred to last year, is still felt. In view, then, of the necessity for the development of all branches of the Chemical Department, it is evident that the entire Walker Building is not too much to devote to chemical purposes, as soon as such a change is made possible by the increase in available buildings.

During the past summer Professor Talbot spent some time in the inspection of laboratories of technical chemistry in Germany and England, and in the examination of the general methods of teaching this subject employed in those countries. During a part of the year Professor Whitney has had a most successful connection with the laboratories of the General Electric Company at Schenectady, which has already resulted in the placing of several of our graduates in positions at that place. Mr. Rolfe has spent part of the year in Porto Rico, in connection with the sugar industries of the island.

Physics and Electrical Engineering.

Increase in the number of students and growth in the various courses of the department have been particularly marked the past year; and the beginning of the present term has found our lecture-rooms and laboratories more severely crowded than ever before,— a condition which, we trust, will be remedied on the erection of a new building in which a part, if not the whole, of our work may find suitable accommodation.

Much new apparatus and machinery has been added to the several laboratories. Especially should be mentioned the addition to our mechanician's shop of a Brown & Sharpe milling machine, the generous gift of Mr. Francis Blake, of the Corporation,— a machine which is of the utmost service in the large amount of construction which is carried on in the department.

In the matter of instruction much good is resulting from a system of conferences which has been introduced into a

portion of our laboratory exercises, especially in the Laboratory of Electrical Measurements. At intervals of a few days the student is subjected to an informal examination by the instructor, and in this way a close watch can be kept upon the work; while, on the other hand, an opportunity is given for valuable personal instruction. Such frequent conferences consume a great amount of time, but in no other way is it possible so to minimize the danger always present in the laboratory of the performance of the work by the student by rule of thumb. This system will be extended in other laboratories as far as the time of the instructors will allow.

The number of students in the Laboratory of Heat Measurements has been very greatly increased by the addition of the fourth-year students in Mechanical Engineering, so that the total number to be accommodated this term is one hundred and seventy-five. The engineering students now receiving instruction in the subject for the first time take up the testing of fuels and the measurement of high temperatures, including the temperature of furnaces. The instruction given to students of the courses in Chemical Engineering and Mining Engineering has been extended to cover the use of electric fusion processes for the preparation of carbides and other applications of the electric furnace.

Somewhat over a year since, as was fully explained in the last President's Report, a new option in electro-chemistry was established in Course VIII. The value of this course seems to have been appreciated by the public, since during the present term eleven students have entered it at the beginning of the second year, and two graduates from other colleges have come to us especially for this work, a number far in excess of the expectations of the department. The instruction of these students in technical electro-chemistry will next year necessitate a special laboratory with suitable equipment for such work, for which the graduate course in mining also calls.

Mr. M. de K. Thompson, for several years an assistant

in the Rogers Laboratory, has been appointed instructor in electro-chemistry, with leave of absence to study abroad. During the past summer Dr. Goodwin and Mr. Thompson have made an extended tour of inspection of the electro-chemical laboratories of the German and Swiss technical schools.

In connection with the erection of the proposed new laboratories of electrical engineering, Professor Puffer was granted a leave of absence for the first half of the present term, and has spent that time in a careful study of the principal foreign schools of electrical engineering, besides visiting many of the leading electrical plants and manufactories in England and on the Continent. He has returned with much valuable information.

An important advance has been made during the past year by the establishment of a graduate course in electrical engineering, open only to students who have completed our own or an equivalent undergraduate course, and leading to the degree of Master of Science. The studies included are almost entirely in advance of any now given in the Institute, and embrace a severe course of advanced study in theoretical and applied electricity, mathematics, and machine design.

Biology.

The appointment of an additional instructor in biology has made it possible to extend and materially improve the course in industrial microscopy which has long been a useful feature of the work of this department. Mr. Charles-E. A. Winslow, a graduate of the Institute in the class of 1898 and a Master of Science in 1899, after two years' service as assistant in biology, has been promoted to an instructorship, and given special charge of this subject.

Professor Sedgwick's work on the "Principles of Sanitary Science and the Public Health," which he has had in hand for three years past, is now in the press of the Macmillan Company. This volume will be of much service both in

our own work of instruction and to those of our graduates who are engaged or interested in civic and sanitary administration or engineering. It is the direct outgrowth of Professor Sedgwick's lectures on the subject.

Professor Hough has published in full in the American *Journal of Physiology* his paper, "Ergographic Studies in Neuro-muscular Fatigue," giving the results of investigation on the general physiology of fatigue, made in this laboratory during the past two years. Mr. Prescott, instructor in industrial biology, has nearly ready to issue from the press of Messrs. John Wiley & Sons, the translation of an important work by Professor Jean Effront of the Zymological Institute in Brussels, on the soluble ferments, or *Enzymes*, bodies of great scientific and practical importance to brewers, vinegar manufacturers, and others engaged or interested in fermentation industries. He is making an important series of studies on the fermentation of cane juice, and the lactic-acid bacteria.

In connection with the recent remarkable advances in our knowledge of the causation of malarial or swamp fever, and the connection of mosquitoes with malaria, mention should be made of valuable investigations by one of the lecturers in this department, Mr. William Lyman Underwood, whose work on the "Drainage, Reclamation, and Sanitary Improvement of Certain Marsh Lands in the Immediate Vicinity of Boston," prepared under the general supervision of Professor Sedgwick, and published in the *Technology Quarterly* last spring, is of more than local interest and importance. A practical extension of his work was a thesis by one of the graduating class in Sanitary Engineering, showing how the improved drainage already effected on the upper marshes might readily be extended by means of tide-gates to a much larger territory between Belmont and the Mystic River.

The greatest need of the Biological Department is still the opportunity for laboratory experiments upon water and sewage and their purification, and in industrial biology,

upon a larger scale than is now possible; and it is greatly to be hoped that means may soon be found to afford these opportunities to our students of biology, sanitary chemistry, and sanitary engineering. The scientific operation and management of the great municipal filtration establishments now being introduced into many of the cities of the United States and Canada require experience and knowledge such as can be derived with the best advantage only from such opportunities for experiment and practice.

General Studies.

Professor Ripley was granted leave of absence in January for the remainder of the academic year, in order to undertake an investigation of transportation for the United States Industrial Commission. A result of this work has been the accumulation of material illustrative of traffic and financial details of railroad administration. Several important gifts have been received, as, for example, that of a large map prepared by Mr. J. C. Stubbs, traffic manager of the Allied Harriman Railroads, showing competitive transcontinental routes in the United States. This map was prepared originally for the proceedings in arbitration relative to differentials upon the Canadian Pacific Railway. Mr. Samuel M. Felton, president of the Chicago and Alton Railroad, has also secured valuable official documents for the library, including reports of the Joint Rate Inspection Bureau at Chicago.

A graduation thesis, entitled "A Statistical Study of the Negroes of Cinclare Central Factory and Calumet Plantation, Louisiana," has been accepted for publication by the Bulletin of the United States Department of Labor, as one of a series dealing with the economic status of the negro in various sections of the South.

The English Department has, by the large increase of students in the first year, been forced to have more instructors. During the first term of the present year five men besides Professor Bates have been employed, one of them having

been called in for the term only. If the number of students is to be as great in the future, some provision will need to be made for increasing the working force of the department permanently.

In second-year English a new departure has been made in having the students write, instead of the essay formerly required, a summary of each lecture in note-books which are subsequently corrected. The plan seems to be working well. This course brings out very strongly, however, the fact that a large majority of students need to be trained to read intelligently. Many of them are hardly able to take from the printed page much beyond the simplest facts; and, in general, their inability to get from literature any clear or forcible impression without the most careful help is striking and discouraging. If the present course in literature could be put into the third year and the time in the second year given to instruction in the line of clear-headed reading, the result would be better, not only in the subject itself, but in the general development of intellectual perception and appreciation.

The number of students from outside courses taking as options Course IX. literature in one form or another is about the same as last year.

Geology.

A new mineralogical collection has been arranged by Dr. Warren, to be used particularly as a reference collection by the students in second-year mineralogy. He has also brought together a collection of crystals, and is mounting them upon small stands of wood for the purpose of teaching crystallography to a greater extent from the natural crystals. A new petrographical microscope of the most approved model has been purchased for the study of thin sections of rocks. About two hundred new sections have been made for the Institute during the past year, and are now ready for use.

The arrangement and the arduous work of labelling the specimens in the palæontological collection have been carried forward in a satisfactory manner. The collection has received numerous accessions as donations. The Institute is now well prepared for giving practical instruction in this branch of geological inquiry, and there is this year a larger class in palæontology than there has been before.

The collections of building stones and of minerals which were sent to the Paris Exposition have been returned in as good condition as could be reasonably expected. The Institute is now supplied with a collection in this line which is not surpassed in any collegiate institution in this country. The Institute has also received a large and valuable collection of coals of different kinds from Colorado.

Professor Crosby spent over three months of the past summer in the West, chiefly in Colorado, Utah, Arizona, and the Yellowstone National Park. His time was mainly divided between original geological investigations and professional work in connection with mines, the latter affording excellent opportunities for the study of ore-deposits and the collection of instructive series of specimens for the Institute collection in economic geology.

The total membership of the classes taught in the department during the year is five hundred and one.

Naval Architecture.

The most notable event of the year is the decision of the Navy Department to send cadets to the Institute to receive special instruction in naval construction. A three years' course for these cadets has been adopted by the Faculty, and has received the approval of the Chief Constructor, covering the work of the third and fourth years of the regular Course in Naval Architecture, and providing for a year of graduate work. This course leads to the degree of Master of Science. At present there are three cadets at the Institute beginning this course. The course includes advanced

work in naval architecture and in warship-design and also advanced mathematics, electrical engineering, steam engineering, and marine engineering. It has a number of special courses, such as sanitation of warships, heating and ventilation of ships, and chemistry of organic materials used in ship-building.

The steady work of the department in securing drawings of ships and their engines, and other data required in ship-design, and the experience of the department in the adaptation of this material to the purposes of instruction, has made it possible to make material improvements in the teaching of ship-design without increasing the allotted time. The design of a ship is given to each student, who develops it alone, and uses it as the basis for computations of stability, strength, and other properties, as well as for instruction in construction and arrangement. Much credit for the recent development in this line is due to Mr. Leland.

The department has been fortunate in making large additions to its collection of drawings of merchant-ships and warships within the last year, and now has a systematized and catalogued file of drawings of ships of various types, arranged so that they may be used, as are such collections in the drawing offices of ship-yards, as a basis for ship-design. Through the liberality of the Navy Department the file of warship drawings is sufficiently complete for purposes of instruction; and this file will doubtless be kept up to date as new work for the Navy is completed. The aid of friends of the Institute is desired to increase the file of merchant-ship drawings, especially of recent ships.

Several models of ships have been added to our collection, notably of several sailing-ships and steamships of recent design presented by Dr. C. G. Weld, and of several wooden ships of about 1840 presented by Mr. C. B. Appleton. The department has added to its collection of instruments a pelorus by Ritchie, an integraph by Coradi, and some integrators by Amsler.

A large number of tests on steamers have been made by

students as the basis of theses. In the preparation of such work, tests were made by students of the class of 1901; and there are now five tests made or arranged for the present fourth-year class.

The work of the department is seriously hampered by the lack of room. To meet the immediate needs of the department, all the allotted space has been thrown into one drawing-room, the model and instrument room, which was also used for storing and caring for drawings and notes, being thereby sacrificed. Even if there were room (as there is not) for drawing-cases in the open drawing-room, our drawings could not be placed in such cases, as all the important drawings were given as confidential information; and the drawings of warships are furnished with that explicit statement. The addition of another professor to the staff of the department calls for a proper private office; and, as the work of the cadets proceeds, it will be desirable, if not imperative, that those in the higher classes be given special facilities and opportunity for uninterrupted work.

It is a matter of congratulation that our graduates have so generally found desirable employment in their profession in private ship-yards or in connection with other shipping interests, and in the bureaus of construction and steam engineering of the Navy Department. Already some of the older men are taking positions of responsibility.

The facilities which have been given for mold-loft work at the Navy Yard have gradually been restricted by the increased activity accompanying the growth of the Navy, until the Institute must look to some way of providing for this important work within its own walls. Methods consonant with the latest practice in some of our best ship-yards may be provided without demanding space beyond the possibilities of the Institute, and steps in that direction should be taken soon if this work is to proceed.

Modern Languages.

The increasing size of the sections and the addition of new courses in Spanish, to meet a growing demand, have greatly increased the work of the department. In view of the fact that instruction in a living language depends less on home work and written examinations than on the direct influence of the individual teacher, the sections in modern languages, to attain the best results, ought not to exceed twenty pupils.

It is gratifying to note the extent to which members of the department are engaging in literary or philological work, in addition to their teaching. The second edition of Professor Rambeau's "Chrestomathie Française," with an introduction upon French pronunciation and the phonetic method, appeared last June; and Professor Rambeau has brought home from France additional material for his history of the French drama. Besides the publications of other members of the department noted elsewhere, the following works are in preparation: a German grammar, by Professor Dippold; Storm's "Geschichten aus der Tonne," edited by Professor Vogel; "Una en Otra," by Fernán Caballero, edited with an introduction, notes, and vocabulary by Mr. Erhardt; and Pierre Loti's "Pêcheur d'Islande," edited by Mr. Goodell.

Mechanic Arts.

The total number of students taking instruction in mechanic arts is two hundred and ninety-four. Many of these take work in more than one subject.

The total numbers of students since 1897–98 are as follows: —

1897–98	210
1898–99	231
1899–00	238
1900–01	272
1901–02	294

The number of students attending the various classes in mechanic arts in the Summer School was twenty-nine.

The machine shop accommodates twenty-three students, and is now filled by the class in machine-tool work, having two sections of twenty-three students each. As was the case last year, several students desiring to take the work had to be excluded on account of lack of lathe equipment. Should the present rate of increase in numbers continue, another section in this subject, necessitating some rearrangement of other courses, will be needed, or some additional lathes will need to be provided.

Instruction rooms similar to that of the machine shop are very much needed and should be provided for the woodworking and forging departments.

The old Brainard milling machine has been exchanged for a modern machine of the same make. A new arbor press and a straightening press have been added to the equipment of the machine shop.

PUBLICATIONS OF MEMBERS OF THE INSTRUCTING STAFF.

Civil and Sanitary Engineering.

G. F. SWAIN.—Reports on Steam and Street Railway Bridges. *Report of the Massachusetts Railway Commission*, pp. 39–44, 80–82. January, 1901.

C. F. ALLEN.—To what Extent and in what Direction is it Desirable for a Professor of Engineering to accept Engineering Employment? *Proceedings of the Society for the Promotion of Engineering Education*, Vol. IX. p. 227.

A. E. BURTON with J. F. HAYFORD, C.E., of the U. S. Coast and Geodetic Survey. Test of the Massachusetts Institute of Technology Tape Apparatus. *Technology Quarterly*, Vol. XIV. pp. 82–88.

F. P. MCKIBBEN.—Fire and Loading Test on a Columbian Fire-proof Floor. *Engineering News*, November 23, 1901.

Mechanical Engineering.

G. LANZA.— Notes on Friction. Revised edition.

G. LANZA.— Laboratoires de l'Institute of Technology à Boston. An abstract is published in the *Proceedings of the Congrès International de Mécanique appliquée*, Paris, 1900.

E. F. MILLER (Editor).— Results of Tests made in the Engineering Laboratories, Number XIII. *Technology Quarterly*, September, 1901.

J. C. RILEY.— The Pulsometer Steam Pump. *Technology Quarterly*, Vol. XIV., No. 3.

Mining Engineering and Metallurgy.

R. H. RICHARDS.— Progress of Gold Milling during 1900. *The Mineral Industry*, Vol. IX. p. 353.

R. H. RICHARDS.— Review of the Literature of Ore-dressing in 1900. *The Mineral Industry*, Vol. IX. p. 731.

H. O. HOFMAN.— Recent Improvements in Lead Smelting. *The Mineral Industry*, Vol. IX. p. 439.

Architecture.

H. W. GARDNER.— Notes on Shades and Shadows. 1901.

Chemistry.

A. A. NOYES and A. G. WOODMAN (Editors).— Review of American Chemical Research for 1901. Reviewers, W. O. Crosby, Henry Fay, A. H. Gill, H. M. Goodwin, H. O. Hofman, F. J. Moore, J. F. Norris, A. A. Noyes, E. H. Richards, G. W. Rolfe, H. P. Talbot, F. H. Thorp, C. H. Warren, A. G. Woodman.

W. R. WHITNEY and J. E. OBER.— The Precipitation of Colloids by Electrolytes. *Journal of the American Chemical Society*, Vol. XXII. p. 842.

HENRY FAY and EDWARD NORTH, 2d.— On the Nature of Lead Amalgams. *American Chemical Journal*, Vol. XXV. p. 216.

HENRY FAY and C. B. GILLSON.— The Alloys of Lead and Tellurium. *Transactions of the American Institute of Mining Engineers*, 1901.

HENRY FAY and H. E. ASHLEY.— The Alloys of Antimony and Tellurium. *Transactions of the American Institute of Mining Engineers*, 1901.

HENRY FAY.— Segregations of Phosphorus in a Piece of Cold Rolled Shafting. *The Metallographist*, April, 1901.

J. F. NORRIS.— Report on the Chemistry of the Purine Group. *American Chemical Journal*, Vol. XXVI. p. 463.

J. F. NORRIS.— On the Non-existence of Trivalent Carbon. *American Chemical Journal*, Vol. XXV. p. 117.

J. F. NORRIS and W. W. SANDERS.— On Triphenylchlormethane. *American Chemical Journal*, Vol. XXV. p. 54.

J. F. NORRIS and W. A. KINGMAN.— On the Isomerism of Selenates and Tellurates. *American Chemical Journal*, Vol. XXVI. p. 318.

J. F. NORRIS and ERIK H. GREEN.— Some New Derivatives of Secondary Butyl Alcohol. *American Chemical Journal*, Vol. XXVI. p. 293.

J. F. NORRIS and ERIK H. GREEN.— The Condensation of Carbon Tetrachloride with Halogen Derivates of Benzene by Means of the Friedel and Crafts Reaction. *American Chemical Journal*, December, 1901.

J. F. NORRIS and GRACE MACLEOD.— On the Preparation of Triphenylmethane. *American Chemical Journal*, December, 1901.

ELLEN H. RICHARDS.— The Cost of Food. John Wiley & Sons, New York, 1901.

ELLEN H. RICHARDS and ISABEL F. HYAMS.— Notes on *Oscillatoria Prolifica* (Greville). *Technology Quarterly*, December, 1901.

A. G. WOODMAN and L. L. CAYVAN.— The Determination of Phosphates in Potable Waters. *Journal of the American Chemical Society*, Vol. XXIII. p. 96.

A. G. WOODMAN and ELLEN H. RICHARDS.— Air Testing for Engineers. *Technology Quarterly*, June, 1901.

A. G. WOODMAN.— A Portable Outfit for Water Analysis. *Technology Quarterly*, December, 1901.

Physics and Electrical Engineering.

C. R. CROSS.— Silas Whitcomb Holman (biographical notice). *Proceedings of the American Academy of Arts and Sciences*, Vol. XXXVI. p. 553. *Science*, Vol. XIII. p. 857, May 31, 1901.

H. E. CLIFFORD.— Notes on Heat. Third revised edition with additions. Printed for use of students in the Institute.

F. A. LAWS.— Physical Laboratory Notes by Silas W. Holman, Part II. Electrical Measurements, Ninth Edition, revised with additions by F. A. Laws. Printed by the Institute.

H. M. GOODWIN.— Notes on Physical Laboratory Experiments in Heat, November, 1901. Printed by the Institute.

L. DERR.— The Precision of the Slide Rule. *Technology Quarterly*, March, 1901. *Railroad Gazette*, August, 1901.

C. L. NORTON.— Some Electrical Furnaces for Laboratory Use. *Electrical World and Engineer*, Vol. XXXVI. p. 957, December, 1900.

C. L. NORTON.— Fire and Load Test on a Concrete Floor. *Insurance Engineering*, Vol. I. p. 481, December, 1900.

Biology.

W. T. SEDGWICK.— On the Origin and Scope of Bacteriology. President's Address, Society of American Bacteriologists. *Science*, January, 1901.

W. T. SEDGWICK.— On the Rise and Progress of Water Supply Sanitation in the Nineteenth Century. *Journal New England Water Works Association*, March, 1901.

T. HOUGH.— Ergographic Studies in Neuro-muscular Fatigue. *American Journal of Physiology*, Vol. V., May, 1901.

R. P. BIGELOW.— The Stomatopoda of Porto Rico. *United States Fish Commission Bulletin*, Vol. II. pp. 149–160. 1901.

R. P. BIGELOW.— Chromosomes and Differentiation. *Reference Hand-book of the Medical Sciences*, Revised Edition, Vol. III. pp. 72–75, 467–469. 1901.

R. P. BIGELOW and H. S. CONANT.— Notes on Variation in the Shells of Purpura-lapillus. *Biological Bulletin*, Vol. II. No. 6, p. 361. 1901.

S. C. PRESCOTT.— On the Applications of Bacteriology to Certain Arts and Industries. *Technology Quarterly*, Vol. XIV. p. 2, June, 1901.

S. C. PRESCOTT and W. L. UNDERWOOD.— On the Cause and Prevention of Sour Peas. *The Canner and Dried Fruit Packer*, February, 1901.

W. L. UNDERWOOD.— On the Drainage, Reclamation, and Sanitary Improvement of Certain Marsh Lands in the Immediate Vicinity of Boston. *Technology Quarterly*, Vol. XIV. No. 1, March, 1901.

C.-E. A. WINSLOW.— On Typhoid Fever at Newport, R.I., in 1900, and its Relation to Defective Sanitation. *Technology Quarterly*, Vol. XIV. No. 2, June, 1901.

C.-E. A. WINSLOW.— Notes and Reviews of Vital Statistics, Statistics of Institutions, etc. *Quarterly Publications of the American Statistical Association*, September, 1900. December, 1900. June, 1901.

General Studies.

D. R. DEWEY.— Education for Commerce. *Technology Review*, April, 1901.

D. R. DEWEY.— Review of Knox's History of Banking in the United States. *American Historical Review*, January, 1901.

D. R. DEWEY.— Review of Bullock's Essays on the Monetary History of the United States. *American Historical Review*, April, 1901.

ARLO BATES.— The Neglected Side of Athletics. *The Forum*, April, 1901.

ARLO BATES.— Life and Letters of To-day. Ten papers. Chicago *Record-Herald*, June, July, and August, 1901.

ARLO BATES.— Talks on Writing English. Second Series. September, 1901.

Geology.

W. O. CROSBY.— Geological History of the Hematite Iron Ores of the Antwerp and Fowler Belt in New York. *Technology Quarterly*, September, 1901.

W. O. CROSBY.— Tripolite Deposits of Fitzgerald Lake, near St. John, New Brunswick. *Technology Quarterly*, June, 1901.

W. O. CROSBY.— Reviews published in the *Technology Quarterly* and in the *American Geologist.*

G. H. BARTON.— Outline of Dynamical and Structural Geology.

G. H. BARTON.— Questions on Dynamical and Structural Geology.

C. H. WARREN.— Mineralogical Notes. *American Journal of Science*, May, 1901.

C. H. WARREN.— Reviews published in the *Technology Quarterly* and in the *American Geologist.*

F. G. CLAPP.— Geological History of the Charles River. *Technology Quarterly*, September and December, Vol. XIV., 1901.

Modern Languages.

A. RAMBEAU.— Chrestomathie Française. Second Edition.

A. RAMBEAU.— Castilian Pronunciation. *Maître Phonétique*, October and November, 1901.

F. VOGEL.— "Lichtenstein" von Wilhelm Hauff. Edited with introduction and notes.

F. H. DIKE.— "Monsieur Bergeret." Extracts from the series "L'Histoire contemporaine," by Anatole France. Edited with introduction and notes.

R. R. GOODELL.— "L'Enfant Espion," and other stories.

THE LIBRARIES.

The total number of additions to the libraries during the year 1900–01 was 4,567, of which 1,376 were by purchase, 920 from the bindery, and 2,271 were gifts. After deducting books counted twice, etc., the total net increase in the size of the library amounts to 3,567 volumes, 803 pamphlets, and 105 maps. The distribution and cost of these is shown in the following table.

TABLE OF THE NET ACCESSIONS FOR THE YEAR 1900–01, WITH THE COST OF THE SAME, AND THE TOTAL CONTENTS OF THE LIBRARIES OF THE INSTITUTE, SEPT. 30, 1901.

LIBRARIES.	Net Increase.				Total Contents.	
	Volumes.	Pamphlets.	Maps.	Cost.	Volumes.	Pamphlets and Maps.
General Library. General	361	208	1	$117.22	4,935	3,933
General Library. English	111	2	—	203.48	2,782	40
General Library. Modern Languages	98	—	1	284.67	932	24
General Library. Military Science	170	—	—	15.50	320	7
Totals	740	210	2	$620.87	8,969	4,004
Architecture	174	3	—	578.98	2,813	213
Biology	164	33	—	258.43	2,535	466
Chemistry	424	41	—	741.38	8,368	1,638
Engineering	589	204	7	894.63	10,081	3,994
Geology	114	53	94	110.89	2,188	974
History and Economics	651	110	1	479.09	10,808	3,336
Mathematics	83	15	—	251.11	1,118	191
Mining	350	64	1	415.48	2,939	494
Physics	277	70	—	501.38	6,982	820
Margaret Cheney Room	1	—	—	—	617	13
Totals	3,567	803	105	$4,852.24	57,418	16,143

The number of serial publications received regularly by the Institute during the year 1900–01 was 798, not including a large number of official reports and bulletins, school catalogues, and the like, which are also received regularly and duly recorded and catalogued. The following table shows the distribution of the serials, exclusive of most of the official reports.

TABLE OF PERIODICALS AND OTHER SERIAL PUBLICATIONS RECEIVED DURING THE YEAR 1900–01.

LIBRARIES.	Number Received.					Estimated Cost.			
	Gifts.	Charged to Department.	Periodical Account. Exch.	Periodical Account. Subs.	Totals.	Departmental Accounts.	Periodical Account. Exch.	Periodical Account. Subs.	Totals.
General	1	13	14*	40	68	$61.12	$31.20	$126.06	$213.18
Architecture	7	10	2	34	53	57.73	4.80	173.49	235.22
Biology	5	7	17*	37	66	24.32	33.60	226.66	278.98
Geology	7	2	3	9	21	13.20	7.20	39.96	59.16
Chemistry	16	27	17	31	91	87.75	40.80	166.18	287.93
Engineering	19	38	66*	55	178	101.65	156.00	230.93	462.58
History and Economics	40	62	4	54	160	115.76	9.60	203.94	327.70
Mathematics	1	—	—	17	18	—	—	63.33	65.33
Mining	11	3	22	23	59	6.83	52.80	88.69	139.52
Physics	15	15	27*	24	81	55.13	60.40	117.45	224.58
Mass. School of Design	—	—	—	3	3	—	—	10.00	10.00
Totals	122	177	172	327	798	$523.49	$398.40	$1,845.09	$2,368.58

The expenditures for the libraries, exclusive of salaries, were as follows: —

Books and binding	$4,852.24
Periodicals	1,923.00
Supplies	141.46
	$6,916.70
Less receipts from the sale of duplicates	130.00
Total	$6,786.70

The General Catalogue contained on September 30 the very considerable number of 53,110 cards, of which 3,316

* More than one publication received in exchange for a single copy of the *Quarterly*.

had been added during the year. There were issued during the year 1,121 orders for new books and 1,135 for binding. In three of the libraries the number of books borrowed during the year was as follows: —

General Library	1,165
Engineering "	1,046
Chemical "	1,894

Among the most noteworthy gifts of the year may be mentioned three handsome volumes on the Eiffel Tower from M. G. Eiffel; from Edward Whymper, Esq., a set of his works; and from Mrs. F. A. Walker, 197 volumes from General Walker's library. We have also received from Mr. John J. May 24 volumes on chemistry, geology, and surveying from the library of the late William C. May of the class of 1873; and Mrs. Dwight N. Marble has presented to the Institute 19 volumes, and a number of pamphlets formerly belonging to her husband, who was of the class of 1895.

STATISTICS.

The Corps of Instructors.

The catalogue of this year shows the number of instructors of all grades to be 149, inclusive of those concerned with the mechanic arts, but exclusive of those who are announced as lecturers for the year only. The addition of these raises the total to 189. This year's catalogue will show a decrease of two in the number of lecturers and some changes in the grades of professors and instructors. Without counting lecturers, the number of instructors to that of students bears the proportion of one to nine and five-tenths. The following table shows the distribution among the several classes of instructors, in comparison with last year: —

	1900–01.	1901–02.
Professors	25	29
Associate Professors	11	9
Assistant Professors	27	25
Instructors	44	50
Assistants	32	36
Lecturers	42	40
Total	181	189

Students and Graduates.

The registration of this year, as shown by the catalogue, amounts to 1,415. The following table shows the registration of successive years from the foundation of the Institute: —

Year.	No. of Students.	Year.	No. of Students.
1865–66	72	1869–70	206
1866–67	137	1870–71	224
1867–68	167	1871–72	261
1868–69	172	1872–73	348

Year.	No. of Students.	Year.	No. of Students.
1873–74	276	1888–89	827
1874–75	248	1889–90	909
1875–76	255	1890–91	937
1876–77	215	1891–92	1,011
1877–78	194	1892–93	1,060
1878–79	188	1893–94	1,157
1879–80	203	1894–95	1,183
1880–81	253	1895–96	1,187
1881–82	302	1896–97	1,198
1882–83	368	1897–98	1,198
1883–84	443	1898–99	1,171
1884–85	579	1899–1900	1,178
1885–86	609	1900–1901	1,277
1886–87	637	1901–1902	1,415
1887–88	720		

Students by Classes.

The aggregate number of students for 1901–02 is divided among the several classes, as follows: —

Fellows	7
Graduate students, candidates for advanced degrees	9
Regular student, Fourth Year	175
" " Third "	179
" " Second "	236
" " First "	396
Special students	413
Total	1,415

Assigning the special students to classes, according to the predominant studies pursued by them, we reach the following division of the whole body among the several years: —

Class.	Regular.	Special.	Total.
Fellows and Graduates of the M.I.T.	16	—	16
Fourth Year	175	93	268
Third Year	179	142	321
Second Year	236	134	370
First Year	396	44	440
Total	1,002	413	1,415

The Courses of Instruction.

The following table presents the number of the regular students in the second, third, and fourth years, by courses: —

Year.	Civil Engineering.	Mechanical Engineering.	Mining Engineering and Metallurgy.	Architecture.	Chemistry.	Electrical Engineering.	Biology.	Physics.	General Course.	Chemical Engineering.	Sanitary Engineering.	Geology.	Naval Architecture.	Total.
4th Year Class .	24	41	14	16	13	31	5	1	3	10	7	—	10	175
3d " "	31	34	35	10	9	26	1	1	1	9	5	1	16	179
2d " "	47	54	27	14	13	39	—	11	5	11	2	—	13	236
Total	102	129	76	40	35	96	6	13	9	30	14	1	39	590

The following table shows the figures of the total line in the foregoing table, in comparison with the corresponding figures for the next ten preceding years: —

Year.	Civil Engineering.	Mechanical Engineering.	Mining Engineering and Metallurgy.	Architecture.	Chemistry.	Electrical Engineering.	Biology.	Physics.	General Course.	Chemical Engineering.	Sanitary Engineering.	Geology.	Naval Architecture.	Total.
1891	81	104	17	33	23	108	11	5	19	28	9	3	—	441
1892	76	106	19	37	35	112	9	5	16	34	5	3	—	457
1893	78	97	22	50	39	141	4	10	19	31	10	2	8	511
1894	88	111	19	48	50	137	5	9	19	35	13	1	20	556*
1895	88	118	25	67	59	126	7	11	14	25	10	3	22	575
1896	99	117	24	65	66	106	7	11	11	34	8	—	25	573
1897	109	119	38	71	60	90	8	9	10	36	7	1	26	578*
1898	93	108	52	64	64	94	6	8	12	38	7	1	33	574*
1899	99	113	60	53	58	84	8	7	11	30	14	1	38	575*
1900	89	127	69	53	50	87	6	4	8	34	17	1	38	582*
1901	102	129	76	40	35	96	6	13	9	30	14	1	39	590

The following table shows, by classes and by courses, the number of regular students who have registered themselves as electing to distribute the required studies and exercises over the period of five years: —

* Deducting those counted twice.

Year.	Total.	Course.											
		I.	II.	III.	IV.	V.	VI.	VII.	VIII.	IX.	X.	XI.	XII.	XIII.
1st . . .	2	–	–	–	–	–	–	–	–	–	–	–	–	–
2d . . .	4	1	2	–	–	–	1	–	–	–	–	–	–	–
3d . . .	4	–	–	2	–	–	1	–	–	–	–	–	–	1
4th . . .	17	4	2	3	–	–	3	–	–	–	3	–	–	2
5th . . .	8	1	4	–	–	–	3	–	–	–	–	–	–	–
	35	6	8	5	–	–	8	–	–	–	3	–	–	3

Classification of Special Students.

Our special students can, of course, not be classified systematically; but the following table exhibits the number of such students pursuing certain leading lines of study: —

Applied Mechanics	115	History	100
Architecture	44	Language	192
Biology	26	Mathematics	180
Chemistry	153	Mechanic Arts	93
Civil Engineering	103	Mechanical Engineering . . .	120
Drawing	155	Mining Engineering	39
Electrical Engineering . . .	33	Naval Architecture	11
English	139	Physics	255
Geology	57	Political Science	97

The following is the number of students, either regular or special, pursuing certain leading branches of study, in each of the four years: —

	First Year.	Second Year.	Third Year.	Fourth Year.	Total.
Mathematics	433	316	133	4	886
Chemistry	447	54	108	75	684
English	391	318	23	5	737
French	203	127	58	—	388
Physics	—	345	317	166	828
German	124	247	171	1	543
Mechanic Arts . . .	6	146	55	56	283

Summer Courses.

The attendance at summer courses this year was as follows: —

Mechanical Drawing and Descriptive Geometry (Professor Faunce),	53
Mathematics: Analytic Geometry (Mr. Passano)	17
Architecture:	
(*a*) Shades and Shadows (Mr. Gardner)	5
(*b*) Elementary Design (Mr. Gardner)	6
Chemistry:	
(*a*) General Chemistry (Mr. Phelan)	23
(*b*) Analytical Chemistry (Mr. Hall)	12
(*c*) Organic Analysis (Dr. Mulliken)	7
(*d*) Organic Chemistry (Dr. Mulliken)	3
Physics:	
(*a*) Mechanics, Light, and Electricity (Dr. Wendell)	37
(*b*) Heat (Professor Clifford)	19
(*c*) Physical Laboratory (Dr. Goodwin)	6
Modern Languages:	
(*a*) French (Mr. Blachstein)	3
(*b*) German (Professor Vogel)	12
Mechanism (Professor Park)	23
Mechanical Engineering Drawing (Professor Park)	19
Mechanic Arts:	
(*a*) Woodwork (Mr. Merrick)	5
(*b*) Forging (Mr. Lambirth)	3
(*c*) Chipping and Filing (Mr. Smith)	2
(*d*) Machine-tool Work (Mr. Smith)	15
(*e*) Metal Turning (Mr. Smith)	3
English Composition (Mr. Robinson)	1

Residence of Students.

States.	Candidates for Advanced Degrees.	Fourth Year.	Third Year.	Second Year.	First Year.	All Regular Students.	Special Students.	Total.
Alabama	–	1	–	–	–	1	1	2
Arkansas	–	–	–	1	–	1	–	1
California	–	–	1	2	2	5	4	9
Colorado	–	1	1	–	–	2	4	6
Connecticut	1	6	4	7	11	29	13	42
Delaware	–	–	1	–	1	2	1	3
Dist. of Columbia,	–	2	2	5	2	11	3	14
Florida	–	–	–	1	–	1	–	1
Georgia	–	–	1	–	2	3	1	4
Hawaiian Islands,	–	–	–	–	–	–	–	–
Idaho	–	–	–	1	–	1	–	1
Illinois	–	7	9	7	7	30	14	44
Indiana	–	–	5	2	2	9	2	11
Iowa	–	–	1	2	2	5	3	8
Kansas	–	–	–	–	–	–	1	1
Kentucky	–	–	–	–	5	5	4	9
Louisiana	–	–	–	–	–	–	1	1
Maine	–	2	5	6	9	22	8	30
Maryland	–	1	2	4	3	10	6	16
Massachusetts	13	114	99	145	254	625	212	837
Michigan	–	2	2	1	2	7	5	12
Minnesota	–	2	2	–	2	6	4	10
Missouri	–	1	1	1	8	11	8	19
Montana	–	–	1	1	–	2	2	4
Nebraska	–	1	–	1	–	2	1	3
Nevada	–	–	–	–	–	–	–	–
New Hampshire	–	2	5	5	8	20	11	31
New Jersey	–	3	–	1	1	5	1	6
New York	1	6	8	17	22	54	25	79
North Carolina	–	–	1	1	1	3	3	6
Ohio	–	1	4	4	8	17	10	27
Oregon	–	–	–	–	1	1	1	2
Pennsylvania	–	5	8	5	6	24	12	36
Porto Rico	–	–	–	–	–	–	1	1
Rhode Island	–	3	6	5	9	23	15	38
South Carolina	–	–	–	1	–	1	2	–	2
South Dakota	–	–	–	1	–	1	2	–	2
Tennessee	–	–	–	1	–	1	1	3	4
Texas	–	–	–	1	–	1	2	3	4	7
Utah	–	–	–	1	–	1	6	1	7
Vermont	–	5	1	4	2	11	4	15
Virginia	–	–	1	1	1	3	2	5
Washington	–	–	–	2	1	4	–	4
West Virginia	–	–	–	–	–	–	1	1
Wisconsin	–	3	–	–	5	8	3	11
Foreign Countries.								
Austria	–	–	–	–	1	1	–	1
Bermuda	–	–	–	–	1	1	1	2
Brazil	–	1	1	–	2	4	–	4
Chili	–	–	–	–	–	–	1	1
China	–	–	–	–	1	1	–	1
Cuba	–	–	–	–	1	1	–	1
Denmark	–	1	–	–	–	1	–	1
England	–	–	–	–	1	1	2	3
France	–	1	–	–	–	1	–	1
Germany	–	1	–	1	–	2	1	3
Jamaica	–	–	–	–	–	–	1	1
Japan	–	–	–	–	–	–	2	2
Mexico	–	–	–	–	4	4	3	7
New Brunswick,	–	–	–	–	1	1	1	2
Nova Scotia	–	–	2	1	1	4	2	6
Ontario	–	–	–	–	1	1	2	3
Quebec	1	–	–	–	–	1	1	2
Russia	–	–	–	–	–	–	1	1
Turkey	–	1	–	–	–	1	–	1
Total	16	175	179	236	396	1,002	413	1,415

Forty-two States of the Union, besides the District of Columbia and Porto Rico, are represented on our list of students. Of the total number of 1,415, 837 are from Massachusetts, or 59.2 per cent. of the whole; 156 are from other New England States; 422 are from outside New England. Of these, 43 are from foreign countries.

A table showing the number of students in each year, from 1895, coming from each State or Territory, and from each foreign country, may be not without interest and instruction: —

	1895.	1896.	1897.	1898.	1899.	1900.	1901.
States.							
Alabama	–	1	1	1	–	1	2
Arkansas	–	1	1	–	–	1	1
California	8	9	9	11	9	10	9
Colorado	7	7	8	8	7	8	6
Connecticut	27	24	30	26	29	35	42
Delaware	5	5	6	3	4	4	3
Dist. of Columbia	16	17	13	8	7	13	14
Florida	1	–	1	–	1	1	1
Georgia	2	3	4	4	3	3	4
Hawaiian Islands	–	–	–	1	–	1	–
Idaho	1	1	1	–	–	–	1
Illinois	42	45	40	51	36	39	44
Indiana	2	3	7	3	5	7	11
Iowa	12	14	12	7	6	10	8
Kansas	4	3	3	–	–	–	1
Kentucky	11	12	10	10	4	5	9
Louisiana	2	–	1	1	1	2	1
Maine	38	27	24	19	25	22	30
Maryland	9	9	8	8	8	13	16
Massachusetts	721	730	739	719	731	779	837
Michigan	7	6	5	9	10	8	12
Minnesota	5	7	8	11	10	7	10
Missouri	9	11	6	10	11	13	19
Montana	1	3	5	2	3	5	4
Nebraska	2	2	2	1	3	4	3
Nevada	–	–	–	–	1	1	–
New Hampshire	30	26	25	25	29	26	31
New Jersey	5	13	15	13	12	8	6
New Mexico	1	–	–	–	–	–	–
New York	64	69	62	68	61	68	79
North Carolina	–	1	1	2	2	2	6
Ohio	37	28	30	23	27	27	27
Oregon	1	4	3	3	2	1	2
Pennsylvania	36	42	41	34	33	37	36
Rhode Island	21	20	19	23	32	35	38
South Carolina	5	6	4	1	1	1	2
South Dakota	–	–	–	–	1	1	2
Tennessee	1	1	3	3	4	6	4
Texas	3	2	2	1	2	4	7
Utah	5	2	3	5	6	7	7
Vermont	5	7	11	12	12	15	15
Virginia	5	3	4	3	2	3	5
Washington	1	5	4	7	4	2	4
West Virginia	3	2	1	–	1	1	1
Wisconsin	7	6	6	8	7	8	11
Wyoming	–	1	–	–	–	–	–
Foreign Countries.							
Austria	–	–	–	–	–	–	1
Belgium	–	–	–	–	–	–	–
Bermuda	–	–	–	–	–	1	2
Brazil	1	–	–	–	–	–	4
Bulgaria	–	–	–	–	–	–	–
Cape Breton	–	–	–	1	–	–	–
Central America	1	–	–	–	–	–	–
Chili	1	1	–	–	–	–	1
China	–	–	–	–	–	–	1
Columbia	–	–	–	–	–	–	–
Cuba	3	2	1	1	–	–	1
Denmark	–	–	2	1	1	1	1
Dutch Guiana	–	–	–	1	1	–	–
England	2	2	2	4	1	3	3
France	–	1	1	1	2	4	1
Germany	–	–	–	1	1	2	3
Guatemala	–	–	–	–	–	–	–
Holland	–	–	–	–	–	–	–
Ireland	–	–	–	–	–	–	–
Jamaica	–	–	–	–	1	1	1
Japan	2	2	–	1	2	2	2
Mexico	1	3	6	7	7	7	7
New Brunswick	1	2	2	3	3	2	2
New South Wales	1	–	–	–	–	–	–
Nova Scotia	2	1	1	2	–	2	6
Ontario	2	2	–	–	–	–	3
Peru	–	–	–	–	–	–	–
Porto Rico	1	–	–	–	–	–	1
Quebec	2	2	2	1	3	4	2
Russia	–	–	–	–	1	1	1
Scotland	–	–	–	–	–	–	–
Spain	1	–	–	–	–	–	–
Trinidad	–	–	–	–	–	–	–
Turkey	3	1	3	3	3	3	1
Venezuela	1	1	–	–	–	–	–
Total	1,187	1,198	1,198	1,171	1,178	1,277	1,415

Residence of Massachusetts Students.

It has been said that 59.2 per cent. of our students are from Massachusetts. All the counties of the State except Dukes send students to the Institute. One hundred and thirty-four cities and towns are on the lists. The first column of the following table shows the number of cities

and towns in each county sending pupils: the second column gives the aggregate number from each county. It appears that Middlesex sends two hundred and forty-six, and Suffolk two hundred and forty-four pupils; Essex comes third, with one hundred and twenty-nine; Norfolk, fourth, with eighty-four.

County.	No. of Towns.	No. of Students.	County.	No. of Towns.	No. of Students.
Barnstable	4	7	Middlesex	31	246
Berkshire	3	3	Nantucket	1	1
Bristol	10	27	Norfolk	19	84
Essex	23	128	Plymouth	15	44
Franklin	5	9	Suffolk	4	244
Hampden	3	16	Worcester	13	25
Hampshire	3	3			
			Total	134	837

The following is a list of the towns, fifty-nine in number, which send five or more students to the Institute:—

Boston	227	Waltham	11	Marlboro	7
Newton	49	Arlington	10	Winchester	7
Cambridge	31	Medford	10	Dedham	6
Newburyport	25	Melrose	10	Middleboro	6
Brookline	23	Springfield	10	New Bedford	6
Salem	23	Taunton	10	Wellesley	6
Somerville	21	Hyde Park	9	Belmont	5
Lawrence	18	Framingham	8	Concord	5
Lowell	18	Gloucester	8	Greenfield	5
Lynn	17	Quincy	8	Holyoke	5
Brockton	13	Canton	7	Stoneham	5
Chelsea	12	Fitchburg	7	Wakefield	5
Malden	11	Haverhill	7	Weymouth	5

The following table exhibits for ten years the distribution of the total number of students among two classes: first, those students whose names are found upon the catalogue of the year preceding; and, secondly, those whose names appear first upon the catalogue of the year to which the statement relates:—

Year.	(1) Total No. of Students.	(2) No. of Students in the catalogue of the previous year who remain in the Institute.	(3) No. of New Students entering before issue of catalogue.	(4) Of those in column (3) the following number are regular First-year Students.	(5) No. of New Students not of the regular First - year Class.
1892–93	1,060	618	442	303	139
1893–94	1,157	701	456	301	155
1894–95	1,183	768	415	271	144
1895–96	1,187	778	409	266	143
1896–97	1,198	758	440	263	177
1897–98	1,198	757	441	277	164
1898–99	1,171	769	402	278	124
1899–1900	1,178	764	414	275	139
1900–1901	1,277	789	488	312	176
1901–1902	1,415	844	571	396	175

Ages of Students.

The next table exhibits the ages of our students upon entrance, after taking out two who are repeating the first year, and seventeen persons of unusual ages. These deductions leave three hundred and seventy-seven as the number of students whose ages have been made the subject of computation.

Period of Life.	1900–1901.		1901–1902.	
	Half-year Groups	Yearly Groups.	Half-year Groups.	Yearly Groups.
16 to 16½ years	1	—	—	—
16½ to 17 "	4	5	4	4
17 to 17½ "	10	—	28	—
17½ to 18 "	41	51	48	76
18 to 18½ "	53	—	47	—
18½ to 19 "	65	118	66	113
19 to 19½ "	55	—	73	—
19½ to 20 "	30	85	41	114
20 to 20½ "	25	—	31	—
20½ to 21 "	18	43	24	55
21 to 22 "	7	7	15	15
	309	309	377	377

The results appear in the table above in comparison with the corresponding results of 1900–1901.

From the foregoing it appears that the average age on entrance is eighteen years and ten months.

In this connection are presented the ages, at graduation, of the class leaving us in June. The one hundred and ninety-two members of the class were distributed among the different periods of life as follows: —

Under 20½	—
Between 20½ and 21	2
" 21 " 21½	8
" 21½ " 22	13
" 22 " 23	54
" 23 " 24	53
" 24 and over	62
Total	192

The special students this year constitute twenty-nine per cent. of the whole body, as against twenty-seven per cent. last year and twenty-six per cent. the year before.

Graduate Students.

The number of students who are graduates of this and other institutions is one hundred and twenty-two. Of these sixteen are our own graduates, nine being candidates for advanced degrees.

One hundred and six are graduates of other institutions, pursuing courses of study with us either as regular or as special students. Thirteen are graduates of Harvard University; six of Yale University; four each, of Amherst College and Brown University; three each, from Columbia and Johns Hopkins Universities and the United States Naval Academy; two each, of Boston, Chicago, Southwestern Presbyterian, Virginia, and Wisconsin Universities, Boston, Christian Brothers, Colby, Davidson, Mt. Holyoke, Neuchâtel, Smith, and Texas Agricultural and Mechanical Colleges; one each, of Acadia, Alabama, Baylor, Cambridge,

Catholic University of America, Cornell, California, Denison, Illinois, Lincoln, Nebraska, Northwestern, Rochester, South, Washington, and Washington and Lee Universities, and of Acadia, Augustana, Beloit, Bowdoin, Canisius, Central, Connecticut Agricultural, Detroit, Earlham, Gallaudet, Grove City, Iowa State, Mt. Alison, the Michigan College of Mines, Oberlin, Pomona, Pennsylvania State, Randolph-Macon, St. Joseph's, St. Ignatius, St. Xavier, Trinity, Tufts, Vassar, Villanova, Wellesley, and Williams Colleges.

Women Students.

The number of women pursuing courses with us is forty-nine. Of these five are graduates of colleges. Of the total number, five are regular students of the fourth year, six of the third year, five of the second year. Thirty-three are special students. Of the sixteen regular students of the upper classes, five take Course IV., Architecture; five, Course V., Chemistry; three, Course VII., Biology; two, Course VIII., Physics; and one, Course IX., General Studies. Of the special students, fourteen devote themselves to biology, four to chemistry, four to general studies, two to physics, one to naval architecture, one to geology, and four to architecture, while three are first-year specials.

Statistics of Admission.

Of the 1,415 students of the present year, 571 were not connected with the school in 1900–1901. Of these 358 were admitted as regular students of the first year upon the basis of their entrance examinations. The 213 remaining comprise (1) those who had previously been connected with the Institute, and have resumed their places in the school; (2) those who were admitted provisionally without examination; (3) those who were admitted by examination as regular second-year or as special students; (4) those who were admitted on the presentation of diplomas or certificates from other institutions of college grade or from the College

Examination Board. In addition to the 358 who were thus admitted to the first year on examination, and have taken their place in the school, 70 were admitted on examination, but have not entered the school.

In the case of the 358 persons who were admitted on examination, and have joined the school, the results of the examinations, embracing both those of June and those of September, were as follows: —

Admitted clear	264
" on one condition	70
" on two conditions	22
" on more than two conditions	2
	358

Fifty-three applicants were rejected.

Entrance Examinations at Distant Points.

In addition to the entrance examinations held at Boston in July and September, examinations were conducted in July at Austin (Tex.), Baltimore, Belmont, Binghamton (N.Y.), Buffalo, Chapel Hill (N.C.), Chicago, Cincinnati, Denver, Detroit, Exeter (N.H.), Indianapolis, Kansas City (Mo.), Lead (S.D.), Louisville, New York, North Adams, Philadelphia, Pittsburg, Portland (Ore.), Portland, (Me.), Pottstown, Rochester, St. Louis, St. Paul, Springfield (Mass.), Syracuse, and Washington, and also in London (England).

Graduates by Courses.

The following table exhibits the number of persons who have graduated within each of the several courses since the foundation of the school: —

Year.	Civil Engineering.	Mechanical Engineering.	Mining Engineering.	Architecture.	Chemistry.	Metallurgy.	Electrical Engineering.	Natural History or Biology.	Physics.	General Course.	Chemical Engineering.	Sanitary Engineering.	Geology.	Naval Architecture.	Total.
1868	6	1	6	–	–	–	–	–	–	1	–	–	–	–	14
1869	2	2	–	–	1	–	–	–	–	–	–	–	–	–	5
1870	4	2	2	–	1	–	–	–	–	1	–	–	–	–	10
1871	8	2	5	–	2	–	–	–	–	–	–	–	–	–	17
1872	3	1	5	–	3	–	–	–	–	–	–	–	–	–	12
1873	12	2	3	1	7	–	–	–	–	1	–	–	–	–	26
1874	10	4	1	1	–	–	–	–	–	2	–	–	–	–	18
1875	10	7	6	1	1	–	–	–	1	2	–	–	–	–	28
1876	12	8	7	–	5	1	–	2	3	4	–	–	–	–	42
1877	12	6	8	4	2	–	–	–	–	–	–	–	–	–	32
1878	8	2	2	3	3	–	–	–	–	1	–	–	–	–	19
1879	6	8	3	1	3	–	–	1	1	–	–	–	–	–	23
1880	3	–	3	–	1	–	–	–	–	1	–	–	–	–	8
1881	3	5	6	3	8	–	–	1	–	2	–	–	–	–	28
1882	2	5	5	3	6	–	–	1	1	1	–	–	–	–	24
1883	3	7	5	1	3	–	–	–	–	–	–	–	–	–	19
1884	5	6	13	–	12	–	–	–	–	–	–	–	–	–	36
1885	4	7	8	2	4	–	2	–	–	1	–	–	–	–	28
1886	9	23	7	1	7	–	10	1	–	1	–	–	–	–	59
1887	10	17	8	1	9	–	8	1	1	3	–	–	–	–	58
1888	11	25	4	5	10	–	17	3	1	1	–	–	–	–	77
1889	14	24	5	3	8	–	17	1	1	2	–	–	–	–	75
1890	25	28	3	5	13	–	18	3	2	6	–	–	–	–	103
1891	18	26	4	6	11	–	23	3	3	1	7	–	1	–	103
1892	22	26	4	13	7	–	36	6	1	7	4	6	1	–	133
1893	25	30	5	2	8	–	41	2	–	6	8	–	2	–	129
1894	21	31	4	14	11	–	33	1	3	5	12	3	–	–	138
1895	25	30	3	15	14	–	33	–	2	4	11	4	–	5	144*
1896	25	34	10	24	17	–	48	3	3	7	7	4	3	5	189*
1897	25	40	7	16	20	–	33	2	3	7	12	4	1	9	179
1898	32	41	7	29	26	–	33	3	4	6	9	3	–	7	200
1899	30	38	9	22	21	–	32	2	2	1	9	1	–	8	173*
1900	32	33	20	21	16	–	22	3	3	5	11	4	–	9	184
1901	37	39	17	21	17	–	25	1	1	6	14	4	1	16	199†
Totals	474	560	205	218	277	1	431	40	36	85	104	33	9	59	2,532
Deduct names counted twice															14
Net total															2,518

*Deducting names counted twice.

†Including two persons awarded degrees on the date of this report.

THE SOCIETY OF ARTS.

Report of the Secretary.

To the President of the Institute:

Sir,— On behalf of the Executive Committee, I have the honor to present the annual report of the Society of Arts for the year May 10, 1900, to May 16, 1901.

The first meeting of the society for the present year was held on October 11, 1900, attendance being one hundred and forty-three. This shows a considerable gain over last year.

The following papers have been read: —

"Color Photography." PROFESSOR LOUIS DERR.

"Some Experiments on Architectural Acoustics." PROFESSOR WALLACE C. SABINE.

"America's Contribution to our Knowledge of the Size and Figure of the Earth." DR. HENRY S. PRITCHETT.

"Applied Science in the Textile World." PRINCIPAL W. W. CROSBY.

"Landscape Architecture in this Country." MR. GUY LOWELL.

"Shipment of Freights to Europe." MR. WILLIAM H. LINCOLN.

"Photography with the Great Visual Telescope of the Yerkes Observatory." PROFESSOR GEORGE E. HALE.

"The Designing of the Buffalo Exposition." MR. ROBERT S. PEABODY.

"A Forest Policy for the United States." MR. GIFFORD PINCHOT.

"The Use of the Microscope in the Study of the Chemical Constitution and Physical Properties of Metals." DR. HENRY FAY.

"Electrical Wave Transmission." PROFESSOR M. I. PUPIN.

"The Increase of the Food Supply of Mankind through the Cultivation of Marine Animals: A Problem in Economic Zoölogy." DR. GEORGE W. FIELD.

"Principles of Action of Various Types of Refrigerating Machines." PROFESSOR J. E. DENTON.

"Cotton from Seed to Bale." MR. HENRY G. KITTREDGE.

At the beginning of the year the Associate Membership was three hundred and ninety-nine. Of this number one has died, nine resigned, twenty-six have, however, been elected, making the present membership three hundred and fifty-six.

During the year the society has suffered the loss of one of its oldest members, Mr. Thomas Gaffield, who served on the Executive Committee from 1879 to 1883. Mr. Gaffield's interests were not confined to the welfare of the Society of Arts alone, but were extended also to that of the Institute, as evinced by his gift of books, specimens of glass and minerals to the Departments of Geology and Chemistry. At the time of his death he was a member of the Corporation of the Institute.

No change has occurred in the management of the *Technology Quarterly*. Since the last annual report twenty-five articles have been published in the *Quarterly*. Probably the most notable article is one on the Eclipse Expedition of the Massachusetts Institute of Technology to Washington, Ga., under the direction of Professor Alfred E. Burton. Illustrating this article is an excellent photogravure reproduction of one of the best photographs of the sun's corona that has ever been taken. This article has been followed by one from Rev. Professor William F. Rigge, S.J., who also observed the eclipse at Washington, Ga., being in charge of a party from Creighton University, Nebraska. In this paper Professor Rigge makes an interesting comparison between his results and those obtained by the party from the Institute, all of which redounds to the credit of both parties. Professor W. O. Crosby has contributed two articles giving the results of his explorations of the sites of proposed water supplies for New York and Brooklyn.

A gratifying instance of the loyalty of our alumni is furnished by the frequency of the contributions of two graduates of the Institute, Messrs. George C. Whipple and Daniel D. Jackson. They are actively engaged in an investigation of problems connected with the biology and physi-

cal characters of the water supplies of towns, and have contributed four articles on different branches of this subject.

Among other articles from the Physical Department, are an account of a series of tests made by Professor Norton on Fire Retardent Materials, and a series on diffusing glass of various kinds used in windows; and from Mr. W. Lincoln Smith an account of an extensive series of Tests of Certain Shades and Globes for Electric Lights as used in Interior Illumination. From the Mechanical Engineering Department the usual annual contribution of Results of Tests made in the Engineering Laboratories was published in the September issue. Professor Fay and Mr. Badlam contributed an important article on the Effect of Annealing upon the Physical Properties and the Microstructure of a Low Carbon Steel; and the Review of American Chemical Research, contributed by a number of members of the Chemical Department, has appeared regularly in each issue. Beginning with the current volume, a change has been made in the paper used in printing the *Quarterly;* and it is hoped that some saving of expense will result.

At the last meeting of the year the thirty-ninth annual meeting, Messrs. George W. Blodgett, Desmond FitzGerald, Edmund H. Hewins, Charles T. Main, and James P. Munroe were re-elected members of the Executive Committee, and Mr. George V. Wendell was re-elected Secretary for the year 1901–1902.

Respectfully submitted,

GEORGE V. WENDELL,
Secretary.

DECEMBER 4, 1901.

GENERAL STATEMENT

OF THE

RECEIPTS AND DISBURSEMENTS BY THE TREASURER

FOR THE YEAR ENDING SEPT. 30, 1901

STATEMENT OF THE TREASURER.

The Treasurer submits the annual statement of the financial affairs of the Institute for the year ending Sept. 30, 1901.

There has been a large increase in the amount received from students' fees, the total this year being about $21,000 greater than last year; but this has been offset by an increase in the amount paid for salaries, for labor, for general expenses, for fuel, for department supplies and other items, so that the net result is an excess of expenditure over income to the amount of $9,590.26,— a deficit about $1,000 greater than last year.

The following legacies and gifts have been received: —

Through the generosity of W. Austin Wadsworth, Esq., and Herbert Wadsworth, Esq., $20,000 has been added to the Edward Austin Fund. From the estate of the late Robert C. Billings has come a legacy of $50,000 for scholarship purposes. $1,655.45 has been added to the Susan E. Dorr Fund. $10,000 for scholarship purposes has been received from the estate of the late Henry Saltonstall, and $40,000 more as a fund for general purposes. $5,000 has been added to the Henry L. Pierce Fund. $1,000 was left to the Institute by the late Miss Rebecca A. Goddard. Mr. George A. Gardner has contributed $10,000 toward the new Electrical Engineering Building. A legacy of $2,000 has come from the estate of the late Barthold Schlesinger. A gift of $2,000 has been made by our ex-President, James M. Crafts. $1,114.62 has been received from the estate of the late John M. Forbes, and $500 from the estate of the late Sarah H. Forbes. Francis Blake, Esq., has contributed $500 for the purchase of apparatus for the physical department, and another friend has given $500 for certain special purposes. Mrs. William B. Rogers gave $400 for periodicals; Mr. Charles C. Jackson, $300 for general purposes; and $153.53 has been added to the Samuel E. Sawyer Fund.

The result is an increase of $99,808.46 in the property held for special purposes, and an increase of $48,000 in that for general purposes; and the net increase in the Institute's property, after deducting the excess of expenditure for the year, and certain other items, is $116,658.04.

Looking back ten years, we find that during that time the receipts from students' fees and scholarships have increased about $60,000, but during the same period the expenditures have increased nearly $139,000. This has been due in great part to the increased number of students, and to the increased demands for more advanced and more varied educational opportunities. The development of technical work and education has made necessary an amount of instruction and of laboratory apparatus far greater than that which sufficed ten years ago.

The gifts to the Institute during this period have been very generous, so that its total property has increased from $1,364,684.98 to $3,456,099.46, of which sum, however, nearly $1,400,000 is in real estate used by the Institute itself, and on the balance a much lower rate of return must now be accepted than that which was received ten years ago. In considering these amounts, the public must bear in mind that a very large proportion of this property is held for special purposes,— notably, scholarships; and such funds, while doing a most beneficent work for the students, do not enable

the Institute to meet its general expenses, since the expense of each student is considerably greater than what he pays. To raise the fees would carry them much beyond those charged in other educational institutions, and would, moreover, bear very hardly on a class of men whose work is of such high order as to entitle them to consideration both from the Institute and from the public.

Judging from the figures for this year, the increase in the number of students in the near future is likely to be very large; and there is imperative need of a large increase in funds to provide the necessary buildings and the necessary instruction.

The poverty of the Institute is the result of the excellence of its work and the reputation which it has attained. The alumni have shown a most loyal interest by contributing $100,000 toward the Walker Memorial Building, of which sum $30,000 has been already paid; but the number of Institute graduates who have been long enough at work to enable them to contribute largely to the support of the Institute is comparatively small, and it is necessary to rely still upon the generosity of the general public to enable the Institute to accomplish for the community the splendid possibilities that are opening before it.

SECURITIES SOLD OR PAID, GENERAL ACCOUNT.

$24,000 Walter Baker Co., Ltd., 4½s	$24,000.00
50,000 Ch. Junc. & U. S. Yards Inc. 5s	50,000.00
House, 34 Commonwealth Ave.	28,681.00
50 Rights Ch., Mil. & St. Paul R.R.	225.00
	$102,906.00

SECURITIES BOUGHT OR RECEIVED AS LEGACIES, GENERAL ACCOUNT.

$50,000 K. C., Fort Scott & Memphis R.R. 6s	1928	$59,640.00
50,000 Long Island R.R. 4s	1949	49,500.00
25,000 Southern Rwy. St. Louis Div. 4s	1951	24,875.00
25,000 Ozark Equipment Co. 5s	1910	25,000.00
		$159,015.00

GEORGE WIGGLESWORTH, TREASURER, *in account with*
GENERAL STATEMENT OF RECEIPTS AND DISBURSEMENTS

Dr.

Cash balance, Sept. 29, 1900		37,831.70
From Augustus Lowell for Lowell Courses	5,756.10	
" " " " C. Kastner's salary	1,458.31	
" " " " School of Design	500.00	7,714.41
RECEIPTS FOR CURRENT EXPENSES.		
Income of funds for salaries	4,314.00	
" " " " scholarships (students' fees),	9,718.63	
" " " " Joy "	200.00	
" " " " Swett "	400.00	
" " " " Savage "	400.00	
" " " " W. B. Rogers	512.50	
" " " " Library	480.00	
" " " " general purposes	24,889.57	
" " Rogers Memorial Fund	10,853.00	
" " Charlotte B. Richardson Fund	1,495.15	
" " Rotch Prize Funds	400.00	
" " Rotch Architectural Fund	1,000.00	
" " Edward Austin Fund, Scholarships	6,725.00	
" " " " " Awards	3,856.55	
" " Teachers' Fund	1,200.00	
Letter Box Fund	81.37	
Students' fees	221,583.00	
State scholarships	4,000.00	
United States Act of 1862	5,468.34	
United States Act of 1890	8,333.34	
Gift of State of Massachusetts	25,000.00	
Laboratory supplies and breakages	10,844.99	
Rents, per Table (page 12)	8,729.93	
Gifts	4,814.62	
Interest	8,578.37	
Boston University	1,150.00	
Sale Printed Lecture Notes	2,805.30	367,833.66
GIFTS AND BEQUESTS FOR SPECIAL PURPOSES.		
Increase Scholarship Funds	881.03	
" Teachers' Fund	2,800.00	
" Edward Austin Fund (add'l $20,000)	23,818.45	
" Susan E. Dorr Fund, additional	1,655.45	
Electrical Engineering Building Fund	10,000.00	
Henry Saltonstall Scholarship Fund	10,000.00	
Billings Student Fund	50,000.00	
Samuel E. Sawyer Fund, additional	153.53	
Sarah H. Forbes Fund	500.00	99,808.46
GIFTS AND BEQUESTS FOR GENERAL PURPOSES.		
Henry L. Pierce Legacy, additional	5,000.00	
Saltonstall Fund	40,000.00	
Rebecca A. Goddard Legacy	1,000.00	
Barthold Schlesinger "	2,000.00	48,000.00
SECURITIES SOLD OR PAID.		
General Fund, page 3		102,906.00
SUNDRIES.		
Income credited to Bond Premium Acc't	3,585.00	
" " " Rogers Bond Premium Acc't,	810.00	
Boston Art Students' Association, on acc't	666.66	
Students' Notes paid	65.00	
Walker Memorial Fund	30,600.00	35,726.66
		$699,820.89

MASSACHUSETTS INSTITUTE OF TECHNOLOGY.
FOR THE YEAR ENDING SEPT. 30, 1901.

Cr.

Paid for Lowell Courses	5,756.10	
" " Charles Kastner's salary	1,458.31	
" " Expense Lowell School of Design	500.00	7,714.41

EXPENSES.

Salaries, per Table (page 12)	263,009.82	
" paid from Gifts	500.00	
Fellowship paid from Swett Fund	400.00	
" " " Savage "	400.00	
Edward Austin Fund, Awards	3,856.55	
Teachers' Fund, "	1,200.00	
Prizes, Rotch Funds	400.00	
Repairs, per Table (13)	9,381.28	
General Expenses, per Table (page 13)	19,331.55	
Fire Insurance	1,782 62	
Fuel	10,901.81	
Water	2,697.20	
Gas	1,917.72	
Electricity	2,039.27	
Printing and Advertising	6,254.45	
" Lecture Notes	3,330.01	
" Annual Catalogues and Reports	3,161.59	
Rents paid Boston & Albany R.R. Co.	180.00	
" " Natural History Society	200.00	
Laboratory Supplies and Libraries, per Table (p. 12)	44,256.00	
" " paid from Gifts	499.50	
Society of Arts	796.71	
Pan-American Exposition	927.84	377,423.92

(Expenses more than Income, $9,590.26)

SECURITIES BOUGHT OR RECEIVED AS LEGACIES.

General Account (page 3)		159,015.00
Walker Memorial Fund		31,788.33

SUNDRIES.

Letter Box, 1900, used	51.12	
Ann White Vose Scholarship Fund, 1900, used	7.67	
Susan E. Dorr " " "	182.37	
Notes Payable	20,000.00	
Notes Receivable	75,000.00	95,241.16
Cash balance, Sept. 30, 1901		28,638.07
		$699,820.89

The following account exhibits the property held by the Institute, as per Treasurer's books, Sept. 30, 1901:—

INVESTMENT OF THE W. B. ROGERS MEMORIAL FUND.

30,000.00	Burlington & Mo. River R.R. 4s.	1910	25,787.50	
27,000.00	Kansas City Belt R.R. 6s.	1916	27,000.00	
6,000.00	New York & New England R.R. 6s.	1905	6,000.00	
3,800.00	Republican Valley R.R. 6s.	1919	3,800.00	
4,000.00	Cin., Ind., St. Louis & Chicago R.R. 6s.	1920	4,000.00	
2,000.00	Kansas City, Fort Scott & Gulf R.R. 7s.	1908	2,000.00	
1,000.00	Lincoln & Northwestern R.R. 7s.	1910	1,000.00	
1,000.00	Atchison & Nebraska R.R. 7s.	1908	1,000.00	
35,000.00	Fort Street Union Depot 4½s.	1941	34,825.00	
24,000.00	Rome, Watertown & Ogdensburg R.R. 5s.	1922	24,000.00	
37,500.00	Detroit, G. Rapids & Western R.R. 4s.	1946	37,500.00	
25,000.00	Atchison, Top. & St. Fé R.R. 4s.	1995	24,470.00	
7,000.00	Chesapeake & Ohio R.R. 5s.	1939	7,000.00	
38,000.00	Chi. Junc. & Union Stock Yards 5s.	1915	38,000.00	
3,000.00	Chi., Mil. & St. Paul R.R. 7s.	1905	3,000.00	
	Advances to Bond Premium account		10.032.50	
	Bonds			249,415.00

INVESTMENTS, GENERAL ACCOUNT.

10,000.00	Bur. & Mo. River (Neb.) R.R. 6s., non-exempt	1918	10,000.00	
2,000.00	Bur. & Mo. River (Neb.) R.R. 6s., exempt	1918	2,000.00	
5,000.00	Chicago, Burlington & Quincy R.R 4s.	1922	4,100.00	
2,000.00	Kansas City, Fort Scott & Gulf R.R. 7s.	1908	2.000.00	
3,000.00	Hannibal & St. Joseph R.R. 6s.	1911	3,000.00	
6,000.00	West End Street Ry. 5s.	1902	6,000.00	
35,000.00	Fitchburg R.R. 5s.	1903	35,000.00	
65,000.00	Boston & Maine R.R. 4½s.	1944	65,000.00	
26,000.00	Am. Dock & Improvement Co. 5s.	1921	26,000.00	
3,000.00	Illinois Central R.R. 4s.	1951	3,000.00	
26,000.00	New York & New England R.R. 6s.	1905	26.000.00	
8,000.00	Chi. Junc. & Union S. Yards 5s.	1915	8,000.00	
5,000.00	Dominion Coal Co. 1st. 6s.	1913	5,000.00	
2,000.00	New England Tel. & Tel. Co. 6s.	1907	2,000.00	
2,000.00	New York & New England R.R. 7s.	1905	2,000.00	
100,000.00	West End Street Ry. 4s.	1917	100,000.00	
50 000.00	Utah & Northern R.R. 1st 7s.	1908	50,000.00	
66,000.00	Walter Baker Co., Ltd., 4½s.	1903	66,000.00	
50,000.00	Chi. Terminal & Transfer Co. 1st 4s.	1947	47,507.50	
120,000.00	Illinois Steel Co., non-conv. 5s.	1913	119,586.25	
43,000.00	Chesapeake & Ohio R.R. 5s.	1939	43,000.00	
100,000.00	Long Island R.R. 4s.	1949	96,137.50	
7,000.00	K. C., Clinton & Springfield R.R. 5s.	1925	6,289.21	
8,500.00	K. C., Mem. & Birmingham R.R. 4s.	1934	8,287.50	
13,000.00	K. C., St. Jo. & Council Bluffs R.R. 7s.	1907	13,000.00	
50,000.00	Kansas City Stock Yards 5s.	1910	50,000.00	
25,000.00	Atchison, Top. & St. Fé R.R. 4s.	1995	25,000.00	
50,000.00	Rio Grande & Western R.R. 4s.	1939	49,180.00	
50,000.00	Oregon R.R. & Navigation Co. 4s.	1946	50,000.00	
50,000.00	Union Pacific R.R. 4s.	1947	50,000.00	
100,000.00	Chic. & W. Michigan R.R. 5s.	1921	100,000.00	
100,000.00	American Tel. & Tel. Co. 4s.	1929	99,875.00	
50,000.00	New England Tel. & Tel. Co. 4s.	1930	50,000.00	
50,000.00	Chi. Junc. & Union S. Yards 4s.	1940	49,250.00	
50,000.00	K. C., Fort Scott & Memphis R.R. 6s.	1928	50,000.00	
25,000.00	Southern Ry., St. Louis Div. 4s.	1951	24,875.00	
25,000.00	Ozark Equipment Co. 5s.	1910	25,000.00	
	Advances to Bond Premium account		44,832.25	
	Bonds			$1,416,920.21
	Amount carried up			$1.666,335.21

Amount brought up $1,666,335.21

STOCKS.

Shares.					
172	Boston & Albany R.R.	par	100	34,456.50	
50	Chi., Milwaukee & St. Paul R.R. Pf.	"	100	6,775.00	
12	Cocheco Manufacturing Co.	"	500	6,000.00	
56	Hamilton Woollen Co.	"	100	5,390.00	
31	Great Falls Manufacturing Co.	"	100	3,472.00	
2	Dwight Manufacturing Co.	"	500	1,600.00	
17	Pepperell Manufacturing Co.	"	100	2,789.50	
10	Lowell Bleachery	"	100	975.00	
27	Essex Co.	"	50	3,780.00	
55	Old Boston National Bank	"	100	5,510.50	
15	Merchants' National Bank	"	100	2,220.00	
25	New England National Bank	"	100	3,875.00	
25	Atlantic National Bank	"	100	2,875.00	
25	National Bank of the Republic	"	100	3,625.00	
40	The Molsons Bank, Montreal	"	50	2,930.00	
37	Nat. Mechanics Bank, Baltimore	"	10	706.70	
64	Boston Real Estate Trust	"	1000	68,909.64	
1	Boston Ground Rent Trust	"	1000	900.00	$156,789.84

INVESTMENT OF THE JOY SCHOLARSHIP FUND.

Massachusetts Hospital Life Insurance Co. .	5,000.00	
Deposits in Savings Banks	4,123.70	9,123.70

INVESTMENT SWETT SCHOLARSHIP FUND.

Massachusetts Hospital Life Insurance Co.	10,000.00

Amount carried up $1,842,248.75

Amount brought up			$1,842,248.75

REAL ESTATE.

Rogers Building		200,000.00	
Walker "		150,000.00	
Land on Garrison Street	50,840.00		
Workshops " "	30,000.00	80,840.00	
Land on Trinity Place	76,315.69		
Engineering B'ld'g, A, Trinity Place,	90,000.00	166,315.69	
Gymnasium Building		7,967.85	
Engineering Building, B		57,857.10	
Lot No. 2, Trinity Place		137,241.60	
Lot No. 3, " "		259,050.00	
Henry L. Pierce Building, Trinity Place		154,297.05	
Boiler and Power House, " "		26,916.74	
Clarendon St. Land and Building		142,762.94	
Real Estate, Massachusetts Ave., Cambridge		16,154.38	1,399,403.35
Equipment, Engineering Building		16,555.24	
" Workshops		20,628.56	37,183.80

SUNDRIES.

Notes Receivable		137,000.00	
Boston Art Students' Association		9,666.66	
Students' Notes		770.50	
Walker Memorial Fund		1,188.33	
Cash Balance, Sept. 30, 1901		28,638.07	177,263.56
			$3,456,099.46

The foregoing property represents the following Funds and Balances, and is answerable for the same.

The income of the following is used for the general purposes of the Institute: —

William Barton Rogers Memorial Fund		250,225.00	
Richard Perkins Fund		50,000.00	
George Bucknam Dorr Fund		49,573.47	
Martha Ann Edwards "		30,000.00	
Nathaniel C. Nash "		10,000.00	
Sidney Bartlett "		10,000.00	
Robert E. Rogers "		7,680.77	
Albion K. P. Welch "		5,000.00	
Stanton Blake "		5,000.00	
McGregor "		2,500.00	
Katharine B. Lowell "		5,000.00	
Samuel E. Sawyer "		4,764.40	
John W. and Belinda Randall Fund		83,452.36	
James Fund		163,654.21	676,850.21
Amount carried up			$676,850.21

Amount brought up		$676,850.21
The income of the following is used towards paying salaries: —		
Nathaniel Thayer, for Professorship of Physics .	25,000.00	
Jas. Hayward, for Professorship of Engineering	18,800.00	
William P. Mason, " " Geology . .	18,800.00	
Henry B. Rogers, for general salaries	25,000.00	
George A. Gardner, " "	20,000.00	
Sarah H. Forbes, "	500.00	108,100.00
SCHOLARSHIP TRUSTS.		
Richard Perkins Fund	53,238.21	
James Savage "	13,978.72	
Susan H. Swett "	10,182.95	
William Barton Rogers Fund	10,666.24	
Joy Fund	9,123.70	
Elisha Thatcher Loring Fund	5,342.57	
Charles Lewis Flint "	5,264.09	
Thomas Sherwin "	5,000.00	
Farnsworth "	5,000.00	
James H. Mirrlees "	2,815.67	
William F. Huntington "	5,216.66	
T. Sterry Hunt "	3,225.32	
Elisha Atkins "	5,000.00	
Nichols "	5,000.00	
Ann White Vose "	60,748.22	
Ann White Dickinson "	40,618.19	
Dalton Grad. Chemical "	6,222.54	
Willard B. Perkins "	6,839.18	
Billings Student "	50,000.00	
Henry Saltonstall "	10,000.00	313,482.26
OTHER TRUSTS.		
Charlotte Billings Richardson Ind. Chem. Fund		37,378.78
Susan Upham Fund		1,297.64
Susan E. Dorr "		11,000.00
William Hall Kerr Library Fund		2,000.00
Charles Lewis Flint " "		5,000.00
Rotch Architectural " "		5,000.00
Rotch Architectural Fund		25,000.00
Rotch Prize "		5,200.00
Rotch "Special" Prize Fund		5,200.00
Edward Austin "		365,034.09
Teachers' "		103,800.00
Saltonstall "		40,200.00
MISCELLANEOUS.		
Students' Deposits	200.00	
Henry L. Pierce Legacy, 1898	800,000.00	
Robert C. Billings Legacy, 1900	92,500.00	
Rebecca A. Goddard " 1901	1,000.00	
Barthold Schlesinger " 1901	2,000.00	
Electrical Engineering Building Fund	10,000.00	
M. I. T. Stock Account	845,856.48	1,751,556.48
		$3,456,099.46

Comparative Statement of Funds, etc.

	Sept. 29, 1900.	Sept. 30, 1901.
Trusts for general purposes	676,696.68	676,850.21
" " Salaries	107,600.00	108,100.00
" " Scholarships	252,808.90	313,482.26
" " Library	7,000.00	7,000.00
Charlotte B. Richardson Ind. Chem. Fund	37,378.78	37,378.78
Susan Upham Fund	1,297.64	1,297.64
Susan E. Dorr "	9,526.92	11,000.00
Rotch Architectural Library Fund	5,000.00	5,000.00
Rotch Architectural Fund	25,000.00	25,000.00
Rotch Prize Fund	5,200.00	5,200.00
Rotch "Special" Prize Fund	5,200.00	5,200.00
John Foster Legacy	10,000.00	
Henry L. Pierce Legacy	795,000.00	800,000.00
John W. Carter "	6,250.00	
Robert C. Billings "	92.500.00	92,500.00
Saltonstall Fund		40,200.00
Electrical Engineering Building Fund		10,000.00
Rebecca A. Goddard Legacy		1,000.00
Barthold Schlesinger "		2,000.00
Edward Austin Fund	341,215.64	365,034.09
Teachers' Fund	101,000.00	103,800.00
Letter Box Fund	51.12	
Students' Deposits	200.00	200.00
Notes Payable	20,000.00	
M. I. T. Stock Account	840.515.74	845,856.48
	$3,339,441.42	$3,456,099.46
Increase,		
Consisting of:		
Bequests for Special Purposes, etc. (See page 4)	99,808.46	
Gifts and Bequests for General Purposes. (See page 4)	48,000.00	147,808.46
Less Funds of 1900, used	241.16	
" Expenses more than Income	9,590.26	
" Loss on Sale of House 34 Commonwealth Ave	1,319.00	
" Notes Payable, paid	20,000.00	31,150.42
		$116,658.04

INCOME FROM GENERAL INVESTMENTS, AND APPLICATION THEREOF.

Applied to Salaries	4,314.00	From Dividends, Bank Stocks	1,000.40
" " Scholarships	10,110.96	" State Tax returned on Bank Stocks	258.81
" " " James Savage Fund	400.00	" Bonds	50,080.63
" " Charlotte B. Richardson Fund	1,495.15	" Dividends, Railroad Stocks	1,862.50
" " Teachers' Fund	4,000.00	" " Manufacturing Stocks	1,048.00
" " Edward Austin Fund	14,400.00	" Real Estate Stocks	2,915.00
" " Rotch Prize Funds	400.00		
" " Rotch Architectural Fund	1,000.00		
" " Library	480.00		
" " General Purposes	24,707.20		
" " Samuel Dorr Annuity	1,000.00		
" " Increase of Funds	881.03		
" " Advances to Bond Premiums	3,585.00		
	$66,773.34		$66,773.34

INCOME FROM WILLIAM BARTON ROGERS MEMORIAL FUND, AND APPLICATION THEREOF.

Paid Massachusetts Institute of Technology	10,253.00	Received Income from Railroad Bonds	11,000.00
Credited to Advances Bond Premiums	747.00		
	$11,000.00		$11,000.00

DETAILS OF SOME ITEMS IN TREASURER'S CASH ACCOUNT.

Rents.

Huntington Hall, for Lowell Lectures	3,500.00	
Lowell School of Design	1,800.00	
Land and Building, Clarendon St., on account	2,500.00	
Use of Rooms and Gymnasium	932.90	
	8,732.90	
Less Tax and Repairs, Cambridge, net	2.97	$8,729.93

Department Supplies.

Chemistry	11,361.72	
Physics	7,595.58	
Mechanical Engineering	4,854.11	
Architecture	3,892.71	
Mining	3,451.59	
Civil Engineering	2,538.58	
Workshops	2,208.68	
Periodicals	1,920.00	
Applied Mechanics	1,328.09	
Biology	1,268.80	
English	1,195.47	
Geology	1,021.11	
Naval Architecture	684.09	
Modern Languages	322.97	
Military	240.89	
Mathematics	203.25	
Drawing	168.36	44,256.00

Salaries.

Instruction	209,191.14	
Administration	25,898.43	
Labor	27,920.25	$263,009.82

General Expense.

Telephone Service, Installing Stations, Rentals, Repairs, etc.		3,023.85	
Postage		3,000.08	
Sundries		2,973.14	
Stationery and Office Supplies		1,494.57	
Electrical Wiring, Lamps, etc.		1,250.04	
Furniture and Window Shades		1,111.23	
Janitors' Supplies		1,002.69	
Examinations		985.07	
Express		700.91	
Diplomas and Commissions		598.10	
Washing		562.51	
Engine Room Supplies:			
Oil	275.39		
Sundries	58.36		
Waste	55.25	389.00	
Library		292.26	
Ice		275.47	
Legal Fees		252.50	
Taxes' Sale, No. 34 Commonwealth Avenue		224.69	
Examination Books		201.16	
Graduation Exercises		191.30	
Gymnasium		184.20	
Glass		182.40	
Removing Ashes		131.30	
Lowell School of Design		125.44	
Street Watering		104.64	
U. S. Vaults		75.00	$19,331.55

Repairs.

Department Improvements:		
Physics	626.80	
Chemistry	468.84	
Mechanical Engineering	375.98	
Mining	286.24	
Workshops	273.18	
Civil Engineering	231.97	
Architecture	219.96	
Drawing	207.78	
English	135.11	
Naval Architecture	97.17	
Geology	60.10	
Biology	50.63	
Applied Mechanics	17.18	
Modern Languages	6.25	
Mathematics	3.88	3,061.07
Rogers Building		1,897.83
Walker "		1,171.18
Sundries		1,065.47
Engineering Building		758.52
Steam Fitting		727.50
Pierce Building		391.85
Gymnasium		202.67
Boiler and Power House		105.19
		$9,381.28

BOSTON, November 29, 1901.

Mr. E. L. Parker, an accountant employed by this committee, has examined the accounts of the Treasurer of the MASSACHUSETTS INSTITUTE OF TECHNOLOGY for the year ending September 30, 1901, and his report is hereto annexed.

We have verified the list of personal property held by the Institute.

CHARLES C. JACKSON,
JAMES P. TOLMAN,
WILLIAM L. PUTNAM,
Members of the Auditing Committee.

BOSTON, November 29, 1901.

To the Auditing Committee of the Massachusetts Institute of Technology:

GENTLEMEN: I have audited the accounts of Mr. George Wigglesworth, Treasurer, for the year ending September 30, 1901.

They are correct, payments duly vouched and the receipts from students' fees and all other income duly accounted for. The cash at office and in banks, according to the deposit books, is correct. The account of property held by the Institute and the funds and balances, as shown in the Treasurer's report of September 30, 1901, is in accordance with the books.

Respectfully submitted,

EDWARD L. PARKER,
Public Accountant.

MASSACHUSETTS INSTITUTE OF TECHNOLOGY

ANNUAL REPORT

OF THE

PRESIDENT AND TREASURER

DECEMBER 10, 1902

BOSTON
GEO. H. ELLIS CO., PRINTERS, 272 CONGRESS STREET
1902

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Members of the Corporation.

President.
HENRY S. PRITCHETT.

Secretary.
FRANCIS H. WILLIAMS.

Treasurer.
GEORGE WIGGLESWORTH.

WILLIAM ENDICOTT.	THOMAS L. LIVERMORE.
HOWARD A. CARSON.	A. LAWRENCE ROTCH.
CHARLES J. PAINE.	JOHN R. FREEMAN.
CHARLES FAIRCHILD.	GEORGE A. GARDNER.
DAVID R. WHITNEY.	WILLIAM H. LINCOLN.
ALEXANDER S. WHEELER.	J. B. SEWALL.
JAMES P. TOLMAN.	CHARLES L. LOVERING.
HOWARD STOCKTON.	A. LAWRENCE LOWELL.
NATHANIEL THAYER.	JAMES P. MUNROE.
CHARLES F. CHOATE.	WILLIAM L. PUTNAM.
HIRAM F. MILLS.	CHARLES G. WELD.
PERCIVAL LOWELL.	EBEN S. DRAPER.
CHARLES MERRIAM.	ROBERT S. PEABODY.
THORNTON K. LOTHROP.	ELIHU THOMSON.
CHARLES C. JACKSON.	ELLIOT C. LEE.
SAMUEL M. FELTON.	JAMES P. STEARNS.
DESMOND FITZGERALD.	LUCIUS TUTTLE.
SAMUEL CABOT.	FREDERICK P. FISH.
FRANCIS BLAKE.	FRANCIS L. HIGGINSON.
CHARLES W. HUBBARD.	CHARLES A. STONE.

On the Part of the Commonwealth.

His Excellency JOHN L. BATES, *Governor.*
Hon. MARCUS P. KNOWLTON, *Chief Justice of the Supreme Court.*
Hon. FRANK A. HILL, *Secretary of the Board of Education.*

Committees of the Corporation.

Executive Committee.

HENRY S. PRITCHETT.
GEORGE WIGGLESWORTH. } *Ex Officiis.*

HOWARD STOCKTON. THOMAS L. LIVERMORE.
FRANCIS H. WILLIAMS. A. LAWRENCE LOWELL.
FREDERICK P. FISH.

Finance Committee.

WILLIAM ENDICOTT. NATHANIEL THAYER.
DAVID R. WHITNEY. CHARLES F. CHOATE.
CHARLES C. JACKSON. JAMES P. STEARNS.

Committee on the Society of Arts.

HOWARD A. CARSON. GEORGE A. GARDNER.
HIRAM F. MILLS.

Auditing Committee.

CHARLES C. JACKSON. JAMES P. TOLMAN.
WILLIAM L. PUTNAM.

Committee on Nominations.

THORNTON K. LOTHROP. GEORGE A. GARDNER.
DAVID R. WHITNEY. HOWARD A. CARSON.
FRANCIS H. WILLIAMS.

Trustees of the Museum of Fine Arts.

HENRY S. PRITCHETT. A. LAWRENCE ROTCH.
FRANCIS BLAKE.

Visiting Committees.

Department of Civil Engineering.

HOWARD A. CARSON. DESMOND FITZGERALD.
CHARLES F. CHOATE. JOHN R. FREEMAN.
LUCIUS TUTTLE.

Departments of Mechanical Engineering and Applied Mechanics.

HIRAM F. MILLS. JAMES P. TOLMAN.
FRANCIS BLAKE. EBEN S. DRAPER.
ELLIOT C. LEE.

Departments of Mining and Geology.

THOMAS L. LIVERMORE. JAMES P. TOLMAN.
CHARLES FAIRCHILD. CHARLES L. LOVERING.
JAMES P. STEARNS.

Department of Architecture.

ROBERT S. PEABODY. ALEXANDER S. WHEELER.
A. LAWRENCE ROTCH. FRANCIS L. HIGGINSON.
JOHN R. FREEMAN.

Department of Physics.

FRANCIS BLAKE. A. LAWRENCE ROTCH.
CHARLES W. HUBBARD. ELIHU THOMSON.

Department of Electrical Engineering.

ELIHU THOMSON. FREDERICK P. FISH,
FRANCIS BLAKE. CHARLES A. STONE.
PERCIVAL LOWELL.

Departments of Literature, History, and Political Economy.

FRANK A. HILL. A. LAWRENCE LOWELL.
CHARLES C. JACKSON. JAMES P. MUNROE.
J. B. SEWALL.

Department of Modern Languages and English.

JAMES P. MUNROE. SAMUEL CABOT.
CHARLES C. JACKSON. J. B. SEWALL.

Department of Mathematics.

PERCIVAL LOWELL. WILLIAM L. PUTNAM.
HOWARD STOCKTON. CHARLES F. CHOATE.

Departments of Chemistry and Chemical Engineering.

SAMUEL CABOT. ELLIOT C. LEE.
HIRAM F. MILLS. CHARLES W. HUBBARD.
ELIHU THOMSON. CHARLES L. LOVERING.

Department of Biology.

JOHN R. FREEMAN. CHARLES G. WELD.
FRANCIS BLAKE. FRANCIS H. WILLIAMS.

Department of Naval Architecture.

CHARLES J. PAINE. WILLIAM H. LINCOLN.
HOWARD STOCKTON. CHARLES G. WELD.

PRESIDENT'S REPORT.

To the Members of the Corporation: —

The year which has passed since my last report has been one of great activity in all the directions in which the work of the Institute lies. The opening of the last term brought an incoming class of more than five hundred, an increase in registration so great as to make necessary the immediate consideration of certain questions to which I shall ask your attention in the course of this report.

Changes in the Corporation.

During the year two members of this body, Mr. Arthur T. Lyman and Mr. Eliot C. Clarke, have resigned on account of the pressure of other duties. One notable figure has passed from our group never to return, Professor and former President Runkle, who died on the 8th of July last not long after his appointment as professor emeritus. Professor Runkle was the last survivor in the Faculty of the group of men who originally formed the Institute. As teacher, as executive officer, and as member of this body he had been with the Institute since its birth, and his death takes away one strong and tender tie which linked us to the past.

I cannot avoid at this moment the mention of one other change which the year has brought. Mr. Alexander S. Wheeler, for twenty-five years a member of the Executive Committee, has found it necessary to give up the active duties which membership in that committee imposes. No truer friend and no wiser counsellor than he has served your body.

We have welcomed to membership with us three new members: Mr. Frederick P. Fish, Mr. Francis L. Higginson, and Mr. Charles A. Stone.

Changes of Faculty and Instructing Staff.

The appointment of Dr. Duncan as head of the new Department of Electrical Engineering is elsewhere referred to. Professor Tyler, who resumed teaching last year, has been appointed head of the Department of Mathematics. The death of Professor Runkle left vacant the Walker professorship of mathematics, to which Professor Osborne has been appointed. Professor W. H. Niles, head of the Department of Geology, after thirty years of service to the Institute, tendered his resignation during the latter part of last year. In accepting it the Executive Committee spread upon its records an expression of its appreciation of his long and faithful service, and conferred upon him the title Professor Emeritus. He still remains, therefore, a member of the Faculty.

During the year the Corporation has elected two non-resident professors. This title has been given to men of distinguished attainments who, while not being bound to the full duties of a professor, nevertheless give courses of instruction. Under this arrangement Mr. Elihu Thomson has been elected Non-resident Professor of Applied Electricity, and Mr. Percival Lowell, Director of the Lowell Observatory at Flagstaff, Arizona, has been elected Non-resident Professor of Astronomy.

Assistant Professors Crosby and Clifford have been promoted to associate professorships in the Departments of Geology and Electrical Engineering respectively. Dr. William H. Walker has been appointed Associate Professor of Industrial Chemistry. Dr. F. Jewett Moore, an instructor of last year, has been promoted to an assistant professorship in the Department of Chemistry, and Dr. James Locke has been newly appointed Assistant Professor of Analytical Chemistry.

Mr. Harrison W. Hayward, an assistant of last year in the Department of Mechanical Engineering, has been promoted to the rank of instructor.

Newly appointed instructors are Dr. George W. Field, in the Department of Biology; Dr. Charles N. Haskins and Mr. Ernest A. Miller in the Department of Mathematics; Mr. Frederick R. Kneeland in Chemistry, Dr. Hermann Kurrelmeyer in Modern Languages, and Mr. Charles Beardsley in Economics. Mr. Robert G. Valentine returns to the Institute this year after an absence of two years, as Instructor in English.

Instructors and assistants who have terminated their connection with the Institute are Messrs. C. M. Fosdick, F. B. Driscoll, and S. L. Wonson of the Department of Civil Engineering; James W. Smith and H. L. Kehl in Mechanical Engineering; John Boyle, Jr., W. W. Garrett and F. H. Sexton, in Mining Engineering; John W. Smith, F. E. Busby, R. W. Balcom, C. Ellis, E. P. Beckwith, and A. C. Davis in Chemistry; W. I. Bickford, F. W. Freeman, H. H. Kennedy and G. Le R. Mitchell in Physics; Miss Alice Loring in Architecture; C. W. Hodsdon and J. C. Woodsome in Mechanical Drawing; J. P. Sanborn in English; and J. A. Frizzell and W. S. Newell in Mechanic Arts and Naval Architecture respectively.

The following assistants have been appointed: Messrs. Allen L. Appleton and Charles F. Willard in Naval Architecture; Chauncey C. Batchelor in English; Dr. Lewis P. Chapin and Messrs. Samuel C. Lind, Benjamin G. Macintire, Champion H. Mathewson, Royal L. Wales, Herbert S. Walker, Francis C. Ware and Robert S. Williams in Chemistry; Arthur Elson, Arthur L. Goodrich, Charles W. Sawyer, and Willis H. Towne in Mechanical or Freehand Drawing; David L. Wing in Economics; Roy G. Burnham, Henry A. Ferrin, Archibald Gardner and Clarence D. Starr in Mechanical Engineering; Kenneth C. Grant, Walter S. Hanna and Arthur T. Nelson in Civil Engineering; Herbert L. Sherman

in Geology; Charles B. Hollis, Charles A. Sawyer, Jr., and Charles H. Sisson, in Mining Engineering and Metallurgy; William H. Reed in Modern Languages; and Clifford M. Swan, Newell C. Page, Fred C. Randall, Irving W. Reynolds, and Orlando S. Stockman, in Physics.

Reorganization of Administrative Work.

The beginning of the present term finds the Institute working under an organization more complete than that which has served it hitherto. The Secretary has for many years had charge of varied duties: not only has he done the work of the Secretary of the Faculty, but he has supervised the registration, the recording, and the work of consultation with students. With the growth of the Institute these duties had become too varied and pressing for one man to perform, and, with the approval of the Executive Committee, the present year has seen a new distribution of duties, by means of which the Secretary is now able to give his time in part to the supervision of the Mathematical Department, and in part to the general duties of administration. The work of registration and of recording has been assigned to other officers, while the general work of consultation with students and the supervision, in particular, of the entering class, has been assigned to a new officer, the Dean. The office of Dean is held by Professor Alfred E. Burton, a graduate of Bowdoin College in the Class of 1878, who has been for some years a professor in the Institute. The office of Registrar is held by Mr. Walter Humphreys, a graduate of the Institute in 1897, while the office of Recorder is held by Mr. O. F. Wells, already familiar with this work through his service in the Secretary's office. Under this arrangement not only is a separation of duties and a corresponding clearness of responsibility attained, but, in addition to this gain, it is made possible for the first-year class to receive as never before the direct attention of an administrative officer.

The needs of student life are being this year further met by the appointment of a Medical Adviser, who has office hours at the Institute twice a week, during which he may be consulted by any student without charge. The services of this officer have been gratefully accepted by the students, many of whom come to Boston as strangers, with no knowledge of medical authorities, and are therefore glad to avail themselves of the advice of a physician who knows from personal experience the problems of student life. The Executive Committee has appointed to this office Dr. Franklin W. White, a graduate of the Institute in the Class of 1890, and of the Harvard Medical School in the Class of 1896.

Some three months ago Mr. Albert M. Knight, who had for thirteen years faithfully served the Institute in the office of Bursar, resigned on account of ill health. He has been succeeded by Mr. F. H. Rand.

Gymnastics and Athletics.

The gymnasium maintained by the Institute, while not of the most modern construction, affords nevertheless full opportunities for exercise. The classes in gymnastics conducted by Dr. Skarstrom, the director of the gymnasium, have been well adapted to meet the physical needs of students. Any student may obtain in the gymnasium such medical advice as he needs and the means for healthful exercise. The gymnasium is under the general direction of the Dean.

For the last two years the athletic efforts of the students have been directed toward class contests rather than toward the more ambitious inter-college contests. After a full discussion by the students, inter-college foot-ball was given up, and the energy which had formerly gone into it was concentrated upon the freshman-sophomore contest, which forms the chief field event of the fall. Outside of this the athletic efforts of students have gone in the main toward the development of track athletics. This is a direction in which the individual

can work without great loss of time, and it seems on the whole the most available direction in which students of technical schools can enter into athletic competition.

Changes in Courses.

For some years members of the instructing staff have conducted summer courses, to which have been admitted both students of the Institute and those who expected to offer themselves for examination in the following autumn. Until the past summer the conduct of these courses has been a personal matter with the instructors, to whom the fees were turned over. A change from this plan was made this year, the Institute assuming charge of these courses and paying the salaries of the instructors. The change has in every way justified itself, from the standpoint both of expense and of service.

By vote of the Executive Committee, it has been decided to discontinue the Course in General Studies, at least in the form in which it is now offered. This course was intended to appeal, from its nature, to a large number of men, being a general rather than a technical course. This has not followed; and, while the work of the course itself and the training which students receive in it have commanded the highest approval, the course has during its existence appealed to but a small number.

No successor has been appointed as head of the Department of Geology, to succeed Professor Niles, whose retirement is earlier referred to, but the work is being conducted, under the general direction of Professor Crosby, by members of the department, with the co-operation of members of the Department of Geology at Harvard University. This co-operation has been effected in the main by the courtesy of the Harvard professors in undertaking courses of lectures and of recitations at the Institute, in part by the admission of Institute students to field courses jointly with Harvard

students, and in part by the admission of advanced students of the Institute to classes at Harvard. Under this co-operation the students of the Institute have enjoyed the opportunities for study offered by both the Institute and the University, and have been able to avail themselves of the instruction offered in the geological departments of both faculties.

The Lowell Laboratory of Electrical Engineering.

In a former report I have called attention to the generosity of two members of our Corporation, Mr. A. Lawrence Lowell, and Mr. Percival Lowell, and of their three sisters, Miss Amy Lowell, Mrs. William L. Putnam and Mrs. T. J. Bowlker in their gift of $50,000. for the purpose of a laboratory of electrical engineering. To this sum Mr. George A. Gardner, another member of the Corporation, added $10,000., Mrs. W. S. Fitz $2,000., and Mr. C. C. Jackson $3,000., making in all a sum of $65,000. In recognition of the great service rendered to the Institute by the late Mr. Augustus Lowell, the Corporation voted to give to the new laboratories his name.

The separation of the Department of Electrical Engineering from that of Physics was announced to your body last year. Last spring the Executive Committee called to the head of the new department Dr. Louis Duncan, some time professor of electrical engineering in Johns Hopkins University, and for some years past a practising engineer in New York City. Dr. Duncan has twice been elected President of the American Institute of Electrical Engineers, and comes to his work as head of our new department with an unusual experience and a thorough and varied training. In view of immediate needs the Executive Committee determined last year to erect on the Trinity Place land a building to serve for this department, and to provide at the same time additional class-rooms for other instruction. This building was begun in July and was pushed to completion with re-

markable rapidity during the summer vacation. It houses, in addition to the Department of Electrical Engineering, part of the work of the Department of Chemistry and the entire Department of Modern Languages. The building is, for the purposes of the Department of Electrical Engineering, almost ideal, and, when the equipment which has been purchased is in place, we shall have in Boston one of the most perfect and at the same time one of the most practical electrical laboratories in the world. The Institute has every reason to congratulate itself upon this step, and upon the prospect which opens before it for a unique contribution to the training of men for this great branch of modern engineering. It may be said in passing that the addition of the forty thousand square feet of laboratory and recitation rooms which this laboratory affords us came none too soon. With the entrance of the freshman class this year, the Institute found its facilities taxed to the utmost, and without this building it would have been almost helpless.

Graduate School of Engineering Research.

Upon the recommendation of the President and Faculty the Executive Committee has determined to inaugurate, with the beginning of the next academic year, a school of engineering research intended to provide facilities for a small number of advanced students who show capacity for original investigation.

While this addition to the work of the Institute is intended as a fitting crown to its structure, and while its purpose is to hold up before our students the idea of a higher professional life and the hope of direct contributions to the world's knowledge, it is also to be remembered that this step is a necessary one in our competition with the technical schools of other countries. The events of the past five years have served to draw attention most sharply to the connection between commercial and industrial advance and commercial and industrial

education. The world has awakened to the fact that education and training in the end outstrip natural ability and untrained initiative, and the civilized nations of the world are bending their energies, in proportion as they are alert, to the problems of technical education. We in America must keep step with the needs of our own country and the efforts of other countries in this direction, and the time has now come when the American engineer must be capable, not only of the most modern practice, but also of conducting investigation and research. To show how clearly our work in this direction is watched and followed, I venture to quote from the inaugural address of the present Rector of the great technical school at Charlottenberg.

"The German need fear in the industrial world neither the Englishman nor the Frenchman, only the American; and to compete with the American engineer, we must strive constantly to improve and extend our engineering courses."

The time has come when the Institute must be not only a teaching body, but it must as well lay the foundations for a school of investigation in the physical sciences. To do this it must establish the conditions which foster that quiet spirit of research upon which all advance and all discovery rest.

Publications of the Institute.

In another part of this report will be found a list of papers and books — in most cases technical — published during the year by members of the instructing staff. The current publications, the Catalogue, the Department Circulars, the Technology Quarterly and the Technology Review have been issued in the usual manner. The Review contains in an interesting and complete form the news of the year, appropriate space being devoted to the discussion of such questions as arise in the conduct of the work itself. It is hoped that

members of the Corporation and of the Alumni may find here an interesting and satisfactory means of keeping in touch with the work of the Institute.

The Increase in Tuition Fee.

The Corporation, since my last report, has voted to raise the annual tuition fee from $200. to $250., this advance to take effect with students entering in September, 1903.

Two distinct plans for providing higher education have been adopted in the various states of the Union. In the great Western States the State University, built and maintained by the people of the whole state, offers the facilities of the college and of the technical school without payment of tuition fee. In our Eastern institutions the state has furnished but a small part of the money necessary to build and maintain colleges and technical schools. These institutions have been in the main founded by private citizens, and are maintained in part by endowment, also the outcome of private generosity, and in part by tuition fees paid by students. Whether the plan of free tuition be the better or not, it would seem practically certain that colleges in New England must depend to a greater or less extent upon tuition fees.

In no institution does the student pay the full cost of his education. The actual cost per student which any college will be called upon to bear will depend upon several factors: the number of students, the facilities offered, and the number and excellence of the instructing staff. In a technical school not only is the expense per student greater than in academic education, but growth of numbers means a far greater growth of expense as compared with college expenses, for such growth means increase in laboratories, expensive in their first cost and expensive to maintain, and it involves a far greater increase in instructing staff than in the case of the teaching of Latin or Greek or history.

The Institute of Technology has but a small endowment in comparison with the larger universities. In addition, a large part of its trust funds is devoted to scholarships, and, as each student costs much more than the amount of tuition, every gift for scholarship purposes increases the load which the endowment carries.

In view of these considerations it has seemed wise to increase the tuition. It is believed that, with a larger grant than heretofore from the Austin Fund for scholarships, this increase will not impose upon students of small means greater difficulties than now present themselves. The annual fee, even with this increase, is still far below the average cost to the Institute for each student.

In comparison with the cost of the ordinary college education it is to be remembered that the technical school not only expends upon each student a much larger sum than the college, but it is also true that the graduate of the college must still prepare himself for a profession after completing his college course, while the graduate of the technical school finds himself in possession of a training which commands an immediate remuneration. For some years the demand for graduates of the Institute has been far in excess of the number of graduates. The value of its diploma will be greater for each graduate in just such measure as its instruction and its facilities are keeping abreast of progress and are in position to profit by all advances.

State Aid to Higher Education.

The difference in the method by which higher education is maintained in the older states of the Union and that adopted in the newer states of the West has already been alluded to. Perhaps few appreciate, however, the difference of cost thereby thrown upon the individual student in the effort to obtain an education.

The University of Michigan, for the year 1901–2, had a

registration of 3,509 students, exclusive of those in the summer school. Of these 2,052 were from the state of Michigan, each of whom paid an annual tuition fee of from $30. to $35. The remaining 1,456 were from other states and territories and from foreign countries. Each of these paid from $40. to $45. annual tuition fee. A matriculation fee of $10. is paid upon entrance. The entire student body of 3,509 students paid into the University treasury tuition and matriculation fees to the amount of $148,515. During the same year 1,415 students in the Institute of Technology paid tuition fees to the amount of $253,000. The difference in the cost to the individual student was made possible by the fact that the University of Michigan received from the state, for the expenses of that year, a contribution of $450,000. Counting interest at 4 per cent. this income is equivalent to that arising from an endowment of more than eleven millions of dollars.

Purchase of Land in Brookline.

During last spring, under the authority granted by the Corporation, the Executive Committee purchased a tract of land, consisting of about twelve acres, in Brookline, in a most attractive region, within easy reach of Jamaica Pond. This purchase was brought about by several considerations, but it was due in the main to the generosity of a member of this Corporation, Mr. Samuel Cabot, who made a gift to the Institute of his share in the property, a gift of the value of some twenty thousand dollars. The Executive Committee was influenced, furthermore, by the fact that this was almost the only remaining piece of land in this region which could be acquired for a reasonable sum, and it was felt that, with the growing needs of the Institute, a use for it would readily be found. A study of the land for the purposes of a student community is now being made.

The Pressure of Increasing Numbers.

Elsewhere, in the statistical part of this report, is given the customary information which is collected from year to year concerning the membership of the student body. I quote from these data the figures which give the registration for the past four years.

1899–1900	1,178
1900–1901	1,277
1901–1902	1,415
1902–1903	1,608

An inspection of these figures shows that the registration of the Institute has increased by more than four hundred in three years, an increase of approximately thirty-five per cent. A further inspection of this registration brings to light several other interesting facts. The distribution of the students of the Institute is very wide. Students are attracted not only from all parts of the Union, but from some twenty foreign countries; and it is particularly interesting to find amongst these numbers a growing attendance from the West and South. One cannot but feel that the bringing together of students from all states is a contribution, not alone to technical education, but to national strength and citizenship as well.

Another interesting and suggestive characteristic of our registration is the increasing number of men who come to us for a technical training after having already received a college education. Approximately one hundred and fifty men enrolled as students at the Institute hold the Bachelor's degree, either of Arts or of Science. The increase in the number of such students is most gratifying. As I have formerly pointed out, the presence of students from outside the United States and from distant states is, perhaps, the best barometer we have for measuring our own standards of work; but from another standpoint, this great growth of registration brings the Corporation face to face with a most serious admin-

istrative problem. Notwithstanding the increase in tuition, the preliminary examinations for next year indicate an entering class in 1903 as large as that of the present year. Upon such growth certain fair limitations, which the Faculty will doubtless impose, may be placed by a more strict scrutiny of the examination papers ; but such restriction as this may in the end have no marked effect upon the attendance, for the rejection of weaker men will continually make the Institute more attractive to the stronger men. While certain causes, such as industrial depression, might temporarily stop the growth of the Institute, there seems no reason to doubt that we may expect, under ordinary conditions, a fairly regular increase in our numbers.

How serious a problem this is may be judged from the statement which I have made in saying that without the addition of the Lowell Laboratory of Electrical Engineering, which was made ready by an unusual effort, the Institute would have been unable, this year, to deal efficiently with the students who came to it. With any continuance of such growth as we have experienced it is absolutely necessary that larger quarters and additional room be furnished within the next two years. At the present time the Institute has at its disposal, not covered with buildings, about 20,000 square feet of land on Trinity Place and 25,000 square feet on Garrison Street. In addition it has the Grundman Studio building on Clarendon Street, which could on the expiration of the present lease be torn down, and which covers a space of 23,280 feet, in all approximately 70,000 square feet. It is evident that these small tracts of land afford no permanent or adequate relief for the development of the immediate future, nor do they solve the difficulty which comes from the overcrowding of the Rogers and Walker Buildings. This question is one which is before you for decision, and at the earliest practicable date. Shall we fit the life and the growth of the school to its present quarters, or shall we find for it a site where it may have room for such growth as it may normally and naturally expect?

The Limitation of Numbers.

The idea has been more than once brought forward that an arbitrary limit should be set to the number of undergraduate students admitted to the Institute, and the plan has long been in force in certain foreign schools of high standing.

While it is desirable to impose conditions of stricter scrutiny upon candidates for admission, so as to keep out those who are intellectually and physically weak, or who are insufficiently prepared, I should be sorry to see arbitrary limitations placed upon incoming students who are well qualified for our work, whether those limitations come in the form of high tuition or in the form of limitation of the number of students. In a growing country, where a continually enlarging demand for technical education will as a matter of course send an increasing number of students into the technical schools, a steady growth in numbers is a natural feature of institutional development. The technical school may well share with the country itself the problem of meeting the demands which a growing constituency implies.

There is, however, another consideration constantly to be kept in mind, and that is the relation of numbers to efficiency. If increase in the number of students is to mean decrease in the efficiency of instruction, then every increase above the point of maximum efficiency is a positive wrong to the students themselves, and will in the end bring down the standard of instruction. Is it possible to allow numbers to increase without any other restriction than those imposed by the requirement of thorough preparation, and yet keep up the standard of instruction or advance it?

I have no hesitation in saying that the problem of maintaining and of improving the efficiency of instruction in technical studies in the face of a growing registration is purely one of administration and of income. A department of civil engineering, for example, with a registration of three hundred students, can be as effectively conducted as a department in

which the registration is only one hundred, but the organization must be fitted to the problem. In the latter case the head of the department will give a large part of the instruction, while in the first he will give only enough to keep in touch with the work, and he will occupy himself in large measure with the administration of the department. But this is only part of the problem. There will be certain subjects in which one man may lecture to three hundred students quite as effectively as to one hundred; but there will be other subjects where one man can teach effectively, thirty, seventy-five or one hundred students, as the case may be, and in these subjects students must be taught in such sections as experience has shown to be effective, and the instructing staff must be increased to meet the new organization. Thus, if the number of students in bridge design becomes too large to be effectively served by one teacher, a second must be provided, and this must not be a young assistant or instructor, but another professor of equal standing with the first.

It is at this point that the dilution of instruction generally begins. As numbers grow, two methods are ordinarily adopted in institutions of learning to meet the demands of the growing classes. The first device is to form the class into a larger number of sections and impose upon a professor who is already working nearly to the limit the heart-breaking task of teaching the same subject two, or even three, times daily to different groups of students. There is no quicker means of killing the enthusiasm of a teacher than to harness him to this sort of intellectual treadmill.

The other method of dealing with the problem is to appoint an additional assistant or instructor. This is better than the first, and, if the assistant or instructor proves to be an able and efficient man, it may solve the problem in many cases. But in certain subjects the work can be done only by a man of experience and of ripe knowledge, and in such cases the institution should face the problem squarely and add to its staff two or three or four professors in the same subject, until

the point of highest efficiency is reached. It goes without saying that such increase in instructing staff carries with it some increase in laboratories, in drawing-rooms, in lecture rooms, and in similar facilities. For, even when the additional professor is secured, he must have a place in which to work, and this in accordance with a feasible scheme of hours and rooms.

Still the essential fact remains that the real limit of the work of an institution is not to be found in the number of its students, but lies rather in the limitations of its administration, of its instructing staff, or of its facilities. If these are made to keep pace with the growth in numbers, the quality of instruction may not only be maintained, but it may be continually advanced. The institution, however, which enters upon such a policy should face the whole situation, it should strengthen its instructing staff to keep pace with its student growth, and should so plan its buildings and its laboratories that they may be expanded with expanding needs.

In closing my reference to this subject, I wish to call attention to the fact that the institution which is large enough to require the services of several teachers in the same technical branch and has resources sufficient to secure men of high quality has a marked advantage in the very fact that a subject is being presented to students by more than one man. For some reason there has been in American colleges a great hesitation to start two men in the same institution upon parallel lines of instruction. Yet this feature of the German university is one of its sources of strength. The fact that the German student may choose not only his subject but his teacher in that subject is a powerful stimulus to good work, and forms one of the influences whereby the competition which goes on in the German universities, instead of being as with us a competition between institutions — too often a competition along purely material lines,— becomes a competition between individuals in the noble rivalry of scholarship. There is no reason why we should not in our institutions avail our-

selves of this same means for quickening the intellectual life and for keeping alive the intellectual alertness of our teachers.

The Problem of the Institute's Location.

As I have already pointed out, the Institute has at command about 70,000 square feet of land upon which it may build. This is wholly inadequate to serve as a basis of development for the future. To purchase additional land adjoining our present site seems to me not only beyond our means, but undesirable as well. It is essentially uneconomical for an institution of learning to occupy land having so high a commercial value.

The time has come, in my judgment, when we should ask the General Court to remove from the land which we own on Boylston Street the restrictions that were placed upon it in the act of gift. In case this is granted, we should then look about for a site of not less than thirty acres, which shall still be near enough to be in touch with the industrial life of the city, which shall be accessible from the various railroad stations, and where the Institute may develop in such way as the demands of the future clearly indicate.

For a discussion of the advantages and disadvantages of such a plan, I refer you to the July number of the *Technology Review*, which most of you have doubtless seen. The arguments on both sides are there summed up as follows.

"These, then, seem to be the seven main disadvantages resulting from a removal of the Institute from Copley Square to some region more distant from the city's centre: —

"1. The labor and controversy of an appeal to the General Court.

"2. A loss of the moral support due to sentiment.

"3. The giving up at least to a considerable degree, of its pre-eminence as the educational focus of Boston.

"4. At least a partial separation of the Institute from those industrial and mercantile interests which have been its main support, and from certain other educational agencies.

"5. Inconvenience of access, causing loss of time and increased expenditure on the part of the students.

"6. The many complications which must arise from the establishment of the residence system.

"7. An increased delay in providing much-needed new buildings."

"The main advantages in favor of removal may then be summed up as: —

"1. Increase of public interest through the conspicuousness of so radical a step.

"2. The possible creation of a new sentiment and affection for the Institute, stronger even than that already existing.

"3. The replanning of the buildings upon a more suitable and unified scheme.

"4. The better housing of the students, together with a supervision of their social life.

"5. Relief from the noise and disturbance inseparable from the present location.

"6. A segregation of buildings and increase in dignity that will make the greatness of the Institute's work more patent.

"7. Closer relations among the officers of instruction, and between them and the undergraduates."

To my thinking the arguments in favor of a transfer of the Institute to an accessible site greatly outweigh those against it. Not only is it true that the overcrowded condition of our buildings is becoming every year more of a source of weakness, that the loss of time in passing from one group of buildings to another is becoming more difficult to bear, but the inconvenience of sending 1600 students back and forth across a crowded highway like Boylston Street is causing each year an increasing loss of time. There is a general ground upon which the whole question rests, which seems to me still more worthy of consideration. It is this: the Institute of Technology exists, not simply as a school to train men for architecture or for engineering, but it exists also as a center of

intellectual and moral activity. As such it should exhibit in the conduct of its work the principles for which it stands. Thus, it has a school of architecture, ably conducted; its buildings ought to express architectural beauty and truth, while standing at the same time for academic simplicity. We maintain courses in heating and ventilation and sanitation, and we should show in the management of our own lecture rooms and laboratories the same principles which we teach. It is impossible to do this in the overcrowded condition of our present buildings.

The Increasing Cost of Student Life.

Over and above all other things, I believe the time has come, particularly in New England, when institutions of learning should set before the eyes of students their own ideals of a wholesome, democratic, and simple college life. Any student of the conditions of American college life can but be alarmed at the increasing sum which is required to send a boy through college; and it is time that some institution should deliberately set itself to work to solve the problem of setting forth a college life that should give to the poor student the opportunity of economical living, and at the same time the opportunity of social intercourse with his fellows. College life has been set at such a pace that the poor student is practically barred from participation in social life, unless he be, perhaps, an athlete and finds his expenses met by his athletic abilities, a state of affairs not wholly desirable. To my thinking there is no better problem to which the Institute can devote itself than to that of furnishing to its students such facilities as will make the student life economical and simple, yet attractive to rich and poor alike.

Should the Institute adopt a plan of removal, I hope that it may undertake to deal with this problem; and in order to do so a system of dormitories or student houses would need to be erected upon the new site. To accom-

plish the end in view, these dormitories or student houses must be maintained in a different way and upon a different principle from those ordinarily adopted. They must not be counted on as a source of revenue, but must be used to furnish the best means of living at little more than cost. I would suggest as an experimental plan some such arrangement as the following: two quadrangles, consisting of four buildings each, each quadrangle accommodating approximately five hundred students, the lower floor of each building to be devoted to sitting rooms and dining rooms, and the upper floors to bedrooms and occasional suites for those who desire more expensive quarters. I should call these houses rather than dormitories, as they will in their essential features be more akin to the English University Houses than to the American dormitories. Each house would form a union, its students meeting in the dining hall and for social intercourse. The entire group of houses would be lighted and heated by a central power plant, in which would be located the central kitchen, a refrigerator plant, and a laundry. With such a plant I believe we might successfully undertake to solve the problem of the economical housing and feeding of students. With proper system and with business methods, buying provisions at wholesale, I have no question but that we could offer the student lodging and food at prices far less than our students now pay for uncomfortable lodgings and for unsanitary food, with the additional advantage that the general mass of students would be thrown together under the influence of a simple and democratic social life.

I am satisfied that few appreciate the economic and hygienic waste which comes in the housing and feeding of a body of students taking up their work in a new and, to most of them, unknown city. Boston is an expensive place as American cities go. The student who comes here from a distant place, particularly if his means are limited, undertakes to house and feed himself as cheaply as possible. In his effort to do so he not only isolates himself from his fellows, but he

oftentimes finds himself in quarters which are morally and physically undesirable. A number of students eat unwholesome and insufficient food, and pay for it prices which, under such a plan as that I have outlined, would furnish wholesome and sufficient food. The entire lack of any plan for the housing and feeding of students involves a moral, economic, and social waste, and I know of no better problem with which an institution like this may deal than that of stopping this waste.

How much the economic waste alone amounts to in the matter of food may be judged from a comparison of the prices paid by our students with the cost of food for the West Point Cadets. The Cadets are, perhaps, the best fed student body in the world. Their meals are simple and wholesome, but are chosen from the best material that the market supplies, and they are cooked after modern sanitary methods. The cost of food and service amounts to but fifty cents a day per man, or $3.50 a week, which is just what the cheapest boarding houses charge Boston students for food far from satisfactory.

This question is worth considering, not only from the standpoint of the student and of his social and physical needs, but also from that of the educational interests of Boston and New England. Boston is not only interested in the work of education, it is interested also in the business of education, and it seeks to encourage by every right means the coming to it of men seeking education. Such exchange increases in the best way the ties which bind New England to the other states, ties which we desire in all ways to foster. Our New England institutions were begun and have prospered as private institutions, without large grants from the state, and they have therefore always been conducted on the theory that a fairly high charge for tuition could rightly be made. The great Western institutions, like those at Madison and Ann Arbor, have grown up under a different theory. In those states the Commonwealth itself undertakes to furnish a free

education of the most complete sort, and the state university forms the apex of the state educational system. The incomes of the state universities are growing year by year, and the facilities which they offer are rapidly becoming comparable with those offered by the strongest New England institutions. Tuition is free, or at most is but a nominal sum, living is cheap, and a student may go to one of these great Western institutions and live for a whole year for the sum required for his tuition alone at the Institute. All these considerations are making, as time goes on, stronger reasons why boys from Texas and California and Missouri and Georgia and other distant states should consider these institutions, rather than those of New England, as places of residence for their student life. Any intelligent plan under which the coming of the student to Boston may be made easier and less expensive, and particularly any plan which will free the stranger from the uncomfortable task of finding quarters in unknown surroundings, which will offer to the student of limited means an easy and direct choice of his student home, and which will make the problems of that home simple, will act as an offset to the considerations which I have mentioned, and will make easier the way of the student to a New England education. The man who can afford it will always come from distant states to New England, so long as our institutions maintain their high standing, so long as their faculties are composed of great teachers, and so long as their facilities are better than those of other regions; but the burden of a high tuition and of expensive living will become a continually increasing barrier, a sort of educational tariff, erected against the student of limited means. The son of the clergyman, of the teacher, of the clerk, of the man of small income, will find it each year harder to obtain an education from us, and will be forced by reason of the increasing cost to turn elsewhere.

An increasing number of students is being attracted each year from New England, from the states of New York and

Pennsylvania, and from the Southern states to the great universities of the central West. No true citizen of the Union regrets this. It will be a fortunate day for our country when the colleges of Louisiana and of the Carolinas are so strong in teachers and equipment as to attract students from Massachusetts and from New Hampshire. But I should be sorry to see the time come when the cost of education in Boston was so great as to limit the number of those who come to us from distant states to the families of the well-to-do, or to those who receive aid from the college endowment.

A member of the Executive Committee will present for your consideration a Memorial to the General Court, praying the removal of the restrictions upon the property of the Institute granted to it by the state in 1861; and this Memorial, if approved by you, will be presented to that body. Pending that action I ask you most earnestly to consider the question which I have presented to you.

Reports of the Departments and Statistics.

There are given in the following pages brief reports by the heads of the various departments, together with statistical information prepared in the office of the Registrar. The information contained in these reports is of the greatest interest, and I commend the statements and tables there presented to your careful inspection.

HENRY SMITH PRITCHETT,
President.

BOSTON, December 10, 1902.

REPORTS FROM THE DEPARTMENTS.

Courses I. and XI. Civil and Sanitary Engineering.

No changes have been made in the course of instruction other than some slight transfers of time made necessary by the rearrangement of the work in geology. The only changes in the force of instruction have been the substitution of three new assistants for three who left last year to engage in practical work. An additional assistant was authorized by the Corporation, but it was impossible to find any one for the position. We have, therefore, a smaller instructing force this year than last, owing to the retirement of Professor Burton from active participation in the work of surveying, of which he previously had charge. The capacity of our drawing rooms, moreover, is severely taxed.

Independent of the increased number of students, the department is seriously hampered by lack of room, on account of the necessity of enlarging the Engineering Library. This library is used by students in Civil and Mechanical Engineering and in Naval Architecture, in which three departments there are more than three hundred students in the upper classes. The library has but three tables available, seating about thirty-six students; while the number of books is increasing so rapidly that another bookcase is imperative, the installation of which will reduce the number of tables to two. In another year or two there will be practically no room in this library for readers. It should be so extended as to include the entire front of the Engineering Building, now occupied by the office of the head of the department and the model room, and additional space should be provided for the department in the Pierce Building. The space now occupied in

that building by the Chemical Department and by the second-year architectural drawing-room is the only space into which this department can expand, and such expansion will soon be necessary, unless the Engineering Library is to become a mere store-room for books.

There has been an even greater demand for our graduates this past year than before. Including the retiring assistants, forty men were available for positions last June. From May 1 to Nov. 1, applications were received for between one hundred and fifty and one hundred and sixty men, and such applications continue to be received almost daily.

The fifteenth session of the Summer School of the department was held during the past summer at Ellsworth, Me. Eleven students were in attendance. The school was in charge of Professor Burton, assisted by Professor Robbins, Professor Barton, Mr. Sweet and Mr. Hosmer, together with Mr. Nelson and Mr. Seabury of the class of 1902.

There was the usual field practice in base-line measurement and triangulation. On the triangulation was based a plane-table survey, the scale being 1 to 5000, with a contour interval of 10 feet. A tide gauge was set up, and a datum plane established as a basis for all levels. A profile was made of some four miles of the Union River valley, and hydraulic measurements were made by means of floats and meters to determine the discharge of this river. An interesting geological section was surveyed with transit and stadia. Astronomical observations were made for the determination of latitude, meridian, and time.

In order to connect the Ellsworth survey with the general system of triangulation of the Atlantic coast, the United States Coast and Geodetic Survey stations on Green Mountain and Blue Hill were occupied, and angles were measured to a new triangulation station in Ellsworth.

On July 2 a portion of the school made a trip to Nova Scotia, visiting the Joggins Coal Mines and fossil beds. On the return a stop was made at Moncton, N.B., and photographs were obtained of the tidal bore.

Course II. Mechanical Engineering.

Attention is again urged to the need for certain additional apparatus, which must be obtained if the laboratory is to continue to hold the position it has held in the past, both in view of the increasing number of students to be provided for, and to enable the department to pursue investigations along certain new lines of great importance from an engineering standpoint. The last addition of any considerable magnitude was made nearly three years ago. A small amount of apparatus is made at the Institute, but these additions are very limited in amount, and much time is required for their completion. An attempt is being made, however, to add to our equipment for testing cement in this way.

A valuable addition has been made to the apparatus of the laboratory in the form of a gift from the Westinghouse Air Brake Company consisting of an entire air brake equipment for a freight train consisting of a locomotive and twenty-five cars. This will make it possible to investigate practical and important questions concerning the working of air brakes.

The drawing-rooms are inadequate for the number of students. In order to accommodate those now taking this work, it will be necessary to substitute tables containing two drawers for those with one, and to assign two students to each table; and this will be necessary, not only throughout the entire room occupied by the second-year class, but also for a considerable portion of that occupied by the third-year class. Additional space will be absolutely essential next year.

During the past summer Professor E. F. Miller visited a large number of European Engineering Laboratories. His observations emphasize the importance, if we are to maintain our place in competition with the great technical schools of the world, of providing additional apparatus of considerable magnitude. Professor Miller's report will appear in an early number of the *Technology Review*.

The American Society of Mechanical Engineers held their spring meeting at the Institute in May, their opening session being held in Huntington Hall. At this meeting addresses of welcome were made by the President of the Institute and by the President of the Boston Society of Civil Engineers. The Society made its headquarters in the Engineering Buildings of the Institute, and the members of the Society visited and inspected the laboratories of the department. The attendance was larger than at any previous meeting, the members and guests present numbering nearly nine hundred.

The American Foundrymen's Association held a successful meeting at the Institute in June, during which the members paid a visit to the laboratories of the department.

In September an enthusiastic meeting of the National Association of Stationary Engineers was held in the rooms of the department, and its laboratories were visited by members of the Association. This meeting was the largest and most successful yet held by the Association, fourteen hundred and sixty-four members and guests being in attendance.

Course III. Mining Engineering and Metallurgy.

During the past year many minor changes have been made in the mining and metallurgical laboratories, as well as important additions to their equipment, all aiming at increased efficiency. Owing to the rapid growth of the department and the introduction of new subject-matter in the work of fourth-year students, there is a strongly felt need for additional space. Particularly is this true as regards the departmental library, which needs more room for additional book-cases and for reading tables.

The departmental library has been enriched by the addition of three complete sets of important periodicals, for one of which, the "Australian Mining Standard," it is indebted to Mr. G. M. Hyams.

The summer school of Mining Engineering was held in Nova Scotia and Cape Breton, thus affording a good opportunity to see the mining of gold and of coal, as well as the coking of coal, the smelting of iron, and the making of steel in open hearth furnaces. Gold mining was studied at Waverley, N.S., where the plant was turning out, stamping, amalgamating, and concentrating fifty tons a day. Visits were made for the study of coal mining to the Drummond Colliery at Westville, N.S., where the slope is about a mile deep, and the whole of the coal is taken out at one time by the use of timbers; later to the collieries of the Dominion Coal Company near Glace Bay, where the coal is mined in rooms, the pillars being removed later; and finally to North Sydney, where the coal has been mined by the pillar and stall method some two miles under the sea. A study was made of the smelting of iron at Ferrona, N.S., where pig iron is made for the steel works at Trenton from Newfoundland ore, and later at the extensive works of the Dominion Iron Company, Cape Breton, where the iron furnaces, steel furnaces and rolling mills are all placed systematically together. The kindness of those in charge of the various mines and works visited, and the many courtesies extended, are here gratefully acknowledged.

The instructing staff consisted of Professor Richards, Mr. Locke and Mr. Sawyer, and nineteen students took advantage of the opportunity.

Course IV. Architecture.

Reference was made last year to the gratifying increase in the number of students returning for graduate work. This year the graduate class is one larger than last. Six of this class, one of whom is a graduate of the Option in Landscape Architecture and another of that in Architectural Engineering, are candidates for the degree of Master of Science.

The choice of studies leading to the advanced degree being made largely by the students themselves, although with the aid and advice of the instructors, it has been of interest to compare for a term of years the selections which have been made, with a view to formulating therefrom a regular graduate course which shall at once be attractive to graduate students and acceptable to the Faculty, and which shall lead to the degree of Master of Science. The department is exceedingly well fitted to care for graduate work, and the evolution of a definite graduate course is not intended to interfere with the present latitude as regards choice of work. It will remain as now a simple matter to make slight variations in individual schedules, according to the option graduated from. The graduate students invariably make much of a course of scientific construction, which is as it should be.

The number of students taking the Option in Architectural Engineering, curiously enough, does not increase, although the demand for its graduates is steady, and exceptionally good positions and salaries have been found for them as soon as they were ready to go forth.

If the time devoted to practical problems based on previously taught theory could be extended through the entire first term of the fourth year, the regular student would gain much and the demand for Option 2 would come only from those to whom the æsthetics of architecture do not appeal.

The department is this year working to its full capacity, and it has been found necessary to make use of the exhibition room for recitation purposes.

The greatest need of the department is a museum of building-models and appliances. The demand is for the best practical training that can be given for immediate usefulness when office life begins, and as an aid to this a well-equipped museum, to which manufacturers would be glad to contribute, would be invaluable.

Courses V. and X. Chemistry and Chemical Engineering.

The most important changes in this department are those made in the instruction in inorganic chemistry and in industrial chemistry. Special effort has been made to enrich the instruction in first-year inorganic chemistry and to increase its effectiveness. The lectures are given by Professor Talbot and nine other members of the instructing staff coöperate with him in the conduct of the recitations and laboratory work. Radical changes have been inaugurated in the laboratory work in industrial chemistry in connection with the appointment of Professor W. H. Walker.

Notwithstanding the expansion of laboratory facilities during the past year, involving adequate provision for the first-year class of five hundred students, there is an imperative need of additional space if the department is to maintain its efficiency. Particularly is this true in connection with the instruction in analytical chemistry: this year all but four desks are occupied, and next year will probably show an increase of thirty students in this branch, for whom provision must be made, with a considerable further increase in 1904. It is impossible that the Walker Building should long accommodate both the Department of Physics and that of Chemistry, and, if the Institute is to remain in its present location, it will be absolutely necessary to provide one or more new buildings for these departments.

With each year the need of additional small laboratories for the use of students in connection with thesis work or advanced research is felt more keenly.

As was pointed out in the report of last year, there is great need of an increase in the instructing force of the department, that each member may be able to devote some time to research and to study, and to summon for this work something more than the remnants of energies practically exhausted by long hours of instruction in the laboratory. This increase, however, will be impossible until provision for

additional space is made, as nearly all space available for a working table or even a writing desk is at present occupied.

A Summer School of Industrial Chemistry was inaugurated last June, attended by fifteen students. The plan of instruction included visits to typical manufacturing plants, representing important chemical industries, the series of visits covering a period of two weeks. The details of the trip were carefully worked out in advance by Professor Thorp, who, with Professor Talbot, accompanied the students, and in connection with the inspection of the plants, conferences were held each evening, at which a brief statement of the principles underlying the processes to be inspected on the following day was given by Dr. Thorp, and reports were made by each member of the school upon a specially assigned portion of the plants inspected during the previous day. Elizabeth, N.J. was made the headquarters of the party for the first week, and Philadelphia for the second week.

The following establishments were visited: — Murphy Varnish Co., Newark, N.J.; Passaic Print Works, Passaic, N.J.; Carl H. Schultz Mineral Water Co., New York; Bowker Fertilizer Co., Elizabeth, N.J.; New Jersey Zinc Co., Newark, N.J.; E. R. Squibb & Sons, Pharmaceutical Chemists, Brooklyn; National Lead Co., New York; Standard Varnish Works, Staten Island; Tide Water Oil Co., Bayonne, N.J.; Vulcanite Portland Cement Co., Vulcanite, N.J.; Bellmark Pottery Co., Trenton, N.J.; Willetts Mfg. Co., Pottery Works, Trenton, N.J.; Whitall, Tatum Co., Glass Works, Millville, N.J.; Booth, Garrett & Blair, Laboratory, Philadelphia; U.S. Mint, Philadelphia; Midvale Steel Co., Philadelphia; Harrison Bros. and Co., General Chemicals, Philadelphia; Barrett Mfg. Co., Coal-tar Distillers, Frankford, Pa.; Dungan, Hood & Co., Tanners, Philadelphia; and the Baldwin Locomotive Works, Philadelphia.

It is thus evident that the students had opportunity to study a considerable variety of processes, and there seems to be no doubt that the first summer school of industrial chemis-

try was successful. That this is true is due, in a large measure, to the courtesy and kindness extended to the Institute party by these firms, as well as by those in immediate control of the works.

It is gratifying to note the uniform earnestness of those taking part in the summer school, both with respect to the inspections during the day and the evening conferences — an earnestness which elicited favorable comment from many manufacturers and teachers with whom the party came in contact.

Course VI. Electrical Engineering.

Since the beginning of the academic year the Department of Electrical Engineering has been located in the new Augustus Lowell Laboratory of Electrical Engineering, which was erected during the summer. This laboratory covers an area of about 45,000 square feet, and, in addition to lecture rooms, contains a laboratory for electrical measurements, photometer rooms, a number of research rooms, and a main power and testing floor 300 feet in length by 40 feet in width. At the end of this testing floor, and separated from it by a wall, is a boiler room with space for boilers aggregating 750 horse-power, of which boilers of 500 horse-power have been ordered and are being installed. The main testing floor will contain the power plant, which consists of one 480-kilowatt, double current set; one 150-kilowatt, three-phase set; two 75-kilowatt, direct current, three-wire machines, and two 25-kilowatt machines, driven by a single engine. In addition there are motor-driven units which include a 100-kilowatt, three-phase, 60-cycle dynamo; a 50-kilowatt, 25-cycle, three-phase machine; a 125-kilowatt, 500-volt, direct current machine, and some smaller units. By using Scott transformers the three-phase current can be changed to two-phase. In addition to these machines there is a number of direct and alternating current dynamos and motors from 30 kilowatts down to one kilowatt, and a great deal of other apparatus such as

static transformers, etc. A very complete set of measuring apparatus is owned by the department, the greater part of which is now available for use. The new laboratory, with its unusual equipment, offers facilities for instruction and research which are unsurpassed in this country or abroad.

A number of changes are contemplated in the courses and in the methods of instruction, to take effect next year. It has not been practicable to modify the course of instruction greatly during the present academic year, though a few additional lectures will be given, including a course on electric railroad work. It is hoped that the facilities for laboratory work will be much better than those for last year, although the delivery of the additional apparatus ordered is not so rapid as could be wished.

Course VII. Biology.

The most striking feature of the year in this department has been its productiveness in research and publication. In January Mr. S. C. Prescott, Instructor in Industrial Biology, brought out, through the press of Messrs. John Wiley & Sons, a translation of an important volume on the soluble ferments, entitled "Enzymes and Their Applications," from the French of Professor Jean Effront, a European authority on the subject connected with the Zymotechnical Institute of Brussels. In May Professor Sedgwick's treatise on the "Principles of Sanitary Science and the Public Health," to which reference was made in the last report, was issued from the press of the Macmillan Company, and has met with a favorable reception both in this country and abroad.

Among the more important contributions from this department to the proceedings of learned societies or to scientific or technical periodicals during the past year may be mentioned a memoir describing the results of extensive experiments on the influence of cold upon the bacillus of typhoid fever, with special reference to the problem of ice-supply and the public health; a paper upon the results of ergographic studies on

the muscular soreness frequently observed after muscular work; the discovery of a remarkable similarity between the common intestinal bacillus often used in tracing sewage pollution and certain lactic-acid bacteria; a bacterial study of the self-purification of streams, carried out upon the Sudbury River; the conditions governing the troublesome occurrence of eels in water works, and suggestions for their control; the sanitary importance, in view of the malaria problem, of goldfish as destroyers of mosquito larvæ; and a report to the Commissioners of Fisheries of the Commonwealth upon the scientific basis of the lobster industry and the causes of the decline of the latter, together with suggestions for radical improvement in the lobster laws of New England.

Classes in physics and chemistry from Boston University have for several years been taught in the Institute laboratories by Institute professors, and, beginning with the present year, the biological classes of that institution will be similarly conducted.

The staff of this department has been enlarged and strengthened by the appointment of George W. Field, Ph.D., as Instructor in Economic Biology. Dr. Field is a graduate of Brown University and of Johns Hopkins University and was, not long before his appointment, Assistant Professor at Brown University and Biologist to the Rhode Island Agricultural Station.

Several young men engaged professionally in fermentation or food-preserving industries, or on the biological side of sanitary engineering, have recently come to the Institute for advanced work in the laboratories of industrial or sanitary biology, and the department seems likely to be called upon henceforward to provide opportunities for the most advanced workers in these subjects, as it is doubtless true that nowhere in this country are better facilities provided for work of this kind than at the Institute. Although the number of regular students in the department has always been small, there is a steady demand, not alone for those who have taken the regu-

lar course, but also for others, especially graduate or special students, who have been able to give one or two years to the advanced work of the department. Its greatest need is larger facilities for experimental work in industrial and in sanitary biology for the benefit of such advanced students. Some relief will probably be found in this direction from the generous gift lately made to the Institute for experiments upon the purification of sewage. The administration of this gift has been placed under the general direction of Professor Sedgwick, who is making plans for its wise and effective use.

Course VIII. Physics.

The expectation of moving from the Walker Building made it inexpedient to attempt large changes in the arrangement or equipment of our laboratories, even when this was possible, and has hindered the development of our work, as has indeed been the case for several years past. There has, nevertheless, been a distinct gain in the facilities of the several branches of the Rogers Laboratory of Physics, and also a very embarrassing increase in the number of students pursuing special work.

The Laboratory of General Physics has been filled to its utmost capacity, and next year it will probably be necessary to keep it open to students continuously from nine o'clock until five. The introduction of a system of weekly conferences on the work of this laboratory, which was instituted last year with students from some of the Courses, has very greatly enhanced the value of the laboratory instruction for these students.

It is worthy of note that all the experimental work in connection with the proposed Insurance Engineering Experiment Station has been carried on in the Rogers Laboratory, and it is hoped that this arrangement may continue until the new station is completed.

For the Option in Electro-Chemistry eighteen students have registered this year, of whom four are graduates of

other colleges, a result which indicates an even greater demand for a course of this character than was anticipated.

The most important change in the Department of Physics has been the separation from it of the work in Electrical Engineering, and the institution of a distinct department for this, a procedure which has been in contemplation for several years, but for which the time has not heretofore seemed ripe. At the date of the institution of the Course in Electrical Engineering, and for a number of years thereafter, this subject was in reality a branch of applied physics, and it was not inappropriate that this Course, which had grown up in the Department of Physics, should remain there; but, with the application of electricity as a source of power, the principal problems to be dealt with came to be so largely of a distinctly engineering character as to make it evident that the best interests of such a course would be secured by placing it upon an independent basis when that should become feasible. It remains true, however, that the work of the Physical and the Electrical Engineering Departments is and always must be closely allied.

The space freed by the removal of the Laboratory of Electrical Engineering will be occupied by the Laboratories of Heat Measurements and Electro-Chemistry, besides affording a small amount of room for thesis work.

Course IX. General Studies.

The most important event in the work of the English Department during the year has been the development and extension of the idea of co-operation with other courses in the third and fourth years. Before this year from the Course in Mining Engineering have been received technical memoirs and from the Course in Architecture architectural studies. These, after having been examined in the several departments to which they belong, come to the English Department for criticism on clearness and effectiveness of expression. The

principle is now extended, in various forms, to the Courses in Mechanical Engineering, Chemistry, Electrical Engineering, Physics, and Sanitary Engineering. This combining of actual technical work with criticism of English has long been urged by the department. In Courses III. and IV. it has proved very helpful, and it seems likely to be no less so in the others where it has now been introduced.

The department is more and more strongly impressed by the great importance of extending freshman English through the second half of the year. By the end of the first term a large proportion of the students have been brought to the point where they have especial need of continued practice. They have gained a sufficient knowledge of the theory of composition, and they have learned to express themselves with clearness and propriety. What they need further — and most seriously need,— is to be held to the practice until their knowledge has ripened into habit. Unless it becomes a habit it is very soon lost altogether. Composition is of no value whatsoever as a mere theory; it must be a practical art or it is nothing. The work of a second term in composition should in value be triple that of the first, and cannot be too strongly insisted upon.

The only notable change in connection with the instruction in history is in dividing the European History class into two sections; and a similar division will be made in first-year United States history. The results of dealing with smaller classes have been good, and there has been a better showing on the part of the students. A new course has been given by Professor Sumner on the History and Art of the Italian Renaissance, for graduate students in architecture.

Course XII. Geology.

During the past year certain changes have been made in the curriculum, with a view to emphasizing the importance of the practical aspects of the science, by devoting more time to

mineralogy, field geology, chemical geology and ore-deposits, and economic and applied geology. Time for these subjects has been obtained by reducing the allowance for dynamical and historical geology. In brief, the idea has been, throughout, to offer to each department such courses in geology as would be most pertinent to its work and needs, and to put the instruction upon the practical basis befitting a technical school. As a general result of the changes here indicated, the more practical work in geology, heretofore restricted to the few students in the Course in Geology, is now given to those in the Courses in Civil Engineering, Mining Engineering, Architecture, and Sanitary Engineering, and to classes aggregating from one hundred to one hundred and fifty students.

Owing to the resignation of Professor Niles and the retirement of Professor Barton from all instruction excepting that given to students of Boston University, there has been a general redistribution of the work of the department, which is now being carried on under the general direction of Professor Crosby, with the co-operation of members of the Geological Department of Harvard University, who have given courses as follows: —

Dr. T. A. Jaggar, Jr., in General Geology, Experimental Geology and Field Geology.

Professor N. S. Shaler, in General Geology

Professor W. M. Davis and Mr. M. A. Read, in Physiography.

Professor R. De C. Ward and Mr. F. M. Wilder, in Climatology.

Professor J. B. Woodworth, in Glaciology.

This co-operation has been of high value to our students, the only difficulties arising being those resulting from conflicts of tabular views and the loss of students' time consequent upon the journey to Cambridge and return.

There is urgent need of more room for the storage and convenient use of the geological collections, as well as for advanced laboratory and experimental work in geology.

Course XIII. Naval Architecture.

In accordance with the decision of the U.S. Navy Department, mentioned in the report of last year, to send its cadets to the Institute for special instruction in naval architecture, four additional cadets were detailed here for the present year. At the end of last year the course provided for these cadets was carefully revised, with the aid of the corps of Naval Constructors, and may now be considered established in a complete and satisfactory form. By the elimination of certain subjects, in which the cadets proved to have had already sufficient instruction, it was found possible to augment the instruction in war-ship design, which, in the hands of Professor Hovgaard, is being developed along the most modern and scientific lines. In view of the extensive application of electricity in ship construction, a course has been laid out, with adequate training in the physical and electrical engineering laboratories.

The establishment of the course for cadets and the consequent strengthening of the department make it possible to offer a graduate course in naval architecture, open to all students properly qualified, in which provision will be made for the study of war-ship design and cognate problems.

Notwithstanding the expansion of the department during the past year, there is an urgent need for additional drawing-room space, as well as for a room for models and other similar material.

Last summer a special summer course of two weeks was given in mold-loft work. For this purpose the lines of the ship selected were drawn to a large scale and were used as the basis for the construction of a full-sized body plan and scrive board. Some of the most progressive shipyards have used similar methods for many years and have found it advantageous to make the large-scale drawings mentioned, on marble slabs. If we are adequately to develop this important method of instruction we should, in like manner, use marble

slabs or some equivalent; the material will not be unduly expensive, but space is now lacking for its proper accommodation.

Through the interest of Dr. Weld the students this year are to be each given an opportunity to make a model of the ship he is designing, in order that he may gain a proper appreciation of the form which his ship-lines represent. A room in the building on Garrison St. has been fitted up with proper benches and tools, and a competent instructor provided. Sufficient time will be allotted from the drawing hours, and it is expected that the work of finishing such models will so interest the students that they will consider it a relaxation from their regular work.

An extensive set of lithograph plates has been prepared under the direction of Mr. Leland, representing the framing and construction of ships in steel and wood, showing the standard forms of construction and various modifications, especially those that have been developed in the American yards. This will enable us greatly to improve the instruction in this important subject.

Mathematics.

The changes in the Department of Mathematics during the past year have been important.

Dr. John D. Runkle, Professor of Mathematics from the foundation of the Institute, retired from active teaching at the beginning of the year in consequence of impaired health, and after several months of failing strength, died early in July. No account of Dr. Runkle's service to the Institute in general, and to the department of mathematics in particular, need here be given. The library of the department, to which his name was attached some years ago, will preserve his memory for those who had not the good fortune of direct association with him.

Instruction in mathematics has been conducted at the In-

stitute heretofore without formal departmental organization. Since Professor Tyler's appointment as head of the department, he has endeavored to initiate, and to some extent to carry out, the following lines of policy : —

An examination of the mathematical preparation which can be secured from secondary schools ;

The determination of the kind and amount of mathematical training required by the professional departments ;

The better adaptation of the undergraduate courses to the work of the schools, on the one hand, and to that of the professional departments on the other ;

The development of mutually helpful relations among members of the department by frequent conferences, not only in regard to mathematical instruction, but in regard to subjects of general mathematical interest.

The department has been strengthened by the appointment of two additional instructors.

Modern Languages.

The Department of Modern Languages is, this year, owing to its transference to the new Lowell Building, working under the most favorable conditions it has yet experienced. All its members have their classes and sections, with the exception of a single section, in this building, and the consequent saving of time and gain in efficiency is most gratifying. This change has made possible a long-desired reorganization of the departmental library, which will render it easier of access to both students and members of the department.

Three courses are now being given in Spanish, for the benefit of the Naval Cadets of Course XIII., and it may seem desirable that this instruction be augmented, next year, by additional exercises in conversation, preferably under the direction of a native teacher.

Mechanic Arts.

The total numbers of students receiving instruction in the Mechanical Laboratories is 347, many of whom take work in more than one subject.

The total numbers of students since 1897–98 are as follows: —

1897–98	210
1898–99	231
1899–00	238
1900–01	272
1901–02	294
1902–03	347

The number of students attending the various classes in the Summer School in Mechanic Arts was fifty-five.

Owing to the continued increase in numbers the special class in drawing and mechanic arts was discontinued this year. The number of sections taking machine-tool work was increased from two to three, all of which are now full. The number of lathes in the machine-tool laboratory should be increased from 23 to at least 30 if we are to care properly for the increasing numbers of students. The sections in forging have been increased from three to five, and nearly all now contain the maximum number of students. To carry on successfully the work in forging and chipping and filing during the second term an additional assistant will be needed.

A plain milling machine has been added to the equipment of the machine-tool laboratory, and the twist drill grinder has been replaced by a more modern one.

As was pointed out in the report of last year, instruction rooms similar to that of the machine-tool laboratory are very much needed.

Mr. R. H. Smith, Instructor in Machine-tool Work, has now nearly ready for publication a text-book of "Machine Construction" for use in his classes.

PUBLICATIONS OF MEMBERS OF THE INSTRUCTING STAFF.

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THE LIBRARIES.

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TABLE OF THE NET ACCESSIONS FOR THE YEAR 1901–1902, WITH THE COST OF THE SAME, AND THE TOTAL CONTENTS OF THE LIBRARIES OF THE INSTITUTE, SEPT. 30, 1902.

Libraries.	Net Increase.				Total Contents.	
	Volumes.	Pamphlets.	Maps.	Cost.	Volumes.	Pamphlets and Maps.
General Library. General	331	153	—	$207.41	5,266	4,086
General Library. English	86	—	—	338.81	2,868	40
General Library. Modern Languages,	49	—	—	95.87	981	24
General Library. Military Science	5	—	—	2.33	325	7
Totals	471	153	—	$644.42	9,440	4,157
Architecture	323	15	—	611.41	3,136	228
Biology	144	28	—	229.42	2,679	494
Chemistry	328	32	—	612.32	8,696	1,670
Engineering	779	58	1	1,293.47	10,860	4,053
Geology	96	4	135	159.07	2,284	1,113
History and Economics	417	51	—	324.11	11,225	3,387
Mathematics	114	7	—	211.42	1,232	198
Mining	296	12	—	472.40	3,235	506
Physics	333	43	—	602.53	7,315	863
Margaret Cheney Room	8	—	—	—	625	13
Totals	3,309	403	136	$5,160.57	60,727	16,682

The number of serial publications received regularly by the Institute during the year 1901–1902 was 881, not including a large number of official reports and bulletins, school catalogues, and the like, which are also received regularly and duly recorded and catalogued. The following table shows the distribution of the serials, exclusive of most of the official reports:

TABLE OF PERIODICALS AND OTHER SERIAL PUBLICATIONS RECEIVED DURING THE YEAR 1901–1902.

LIBRARIES.	Number Received.					Estimated Cost.			
	Gifts.	Charged to Department.	Periodical Account.		Totals.	Departmental Account.	Periodical Account.		Totals.
			Exch.	Subs.			Exch.	Subs.	
General	35	18	16	38	107	$77.13	$32.00	$119.95	$229.08
Architecture	6	8	3	32	49	36.89	6.00	151.92	194.81
Biology	4	19	19	34	76	53.38	38.00	191.66	283.04
Geology	9	2	6	7	24	2.45	12.00	30.71	45.16
Chemistry	17	32	16	29	94*	109.77	32.00	160.68	302.45
Engineering	20	51	69	57	197	131.25	138.00	224.74	493.99
History and Economics,	51	54	2	58	165	93.93	4.00	175.68	273.61
Mathematics	—	3	—	13	16	7.66	—	53.48	61.14
Mining	8	7	28	21	64	26.64	56.00	82.66	165.30
Physics	14	18	34	23	89	63.80	68.00	114.39	246.19
Totals	164	212	193	312	881	$602.90	$386.00	$1,305.87	$2,294.77

The expenditures for the Libraries, exclusive of salaries, were as follows:

Books and Binding	$5,160.57
Periodicals	1,753.64
Supplies	244.71
Total	$7,158.92

The General Catalogue contained on September 30th the very considerable number of 55,941 cards, of which 2,831 had been added during the year. There were issued during the year 1199 orders for new books, and 1265 for binding. In

* Not including experiment station reports.

five of the libraries the number of books borrowed during the year was as follows:

General Library	1383
Engineering "	962
Chemical "	1893
Mining "	230
Biological "	157

Among the most noteworthy gifts of the year may be mentioned the sum of $210 for periodicals from Mrs. William B. Rogers; from Mrs. Waldo O. Ross, "the Gardener's Chronicle" besides 290 books and pamphlets on botanical subjects; from Miss Annie Q. T. Parsons, "Knight's Shakespere" for the Margaret Cheney Reading Room; from Professor William H. Niles, 5 volumes on biological subjects. We have received also from Mr. A. J. Sweet, and other Cornell students, "the Cornell Daily Sun." Mrs. Henry Draper has sent another part of "Die Architektur der Renaissance in Toscana." From Yale University we have received 10 volumes of the Bicentennial Publications.

STATISTICS.

The Corps of Instructors.

The Catalogue of this year shows the number of instructors of all grades to be 165, inclusive of those concerned with the mechanic arts, but exclusive of those who are announced as lecturers for the year only. The addition of these raises the total to 183. This year's Catalogue will show a decrease of twenty-two in the number of lecturers and some changes in the grades of professors and instructors. Without counting lecturers, the number of instructors to that of students bears the proportion of one to nine and seven-tenths. The following table shows the distribution among the several classes of instructors, in comparison with last year: —

	1901–02.	1902–03.
Professors	29	28
Associate Professors	9	12
Assistant Professors	25	25
Instructors	50	54
Assistants	36	46
Lecturers	40	18
Total	189	183

Students and Graduates.

The registration of this year, as shown by the Catalogue, amounts to 1,608. The following table shows the registration of successive years from the foundation of the Institute: —

Year.	No. of Students.	Year.	No. of Students.
1865–66	72	1870–71	224
1866–67	137	1871–72	261
1867–68	167	1872–73	348
1868–69	172	1873–74	276
1869–70	206	1874–75	248

Year.	No. of Students.	Year.	No. of Students.
1875–76	255	1889–90	909
1876–77	215	1890–91	937
1877–78	194	1891–92	1,011
1878–79	188	1892–93	1,060
1879–80	203	1893–94	1,157
1880–81	253	1894–95	1,183
1881–82	302	1895–96	1,187
1882–83	368	1896–97	1,198
1883–84	443	1897–98	1,198
1884–85	579	1898–99	1,171
1885–86	609	1899–1900	1,178
1886–87	637	1900–1901	1,277
1887–88	720	1901–1902	1,415
1888–89	827	1902–1903	1,608

Students by Classes.

The aggregate number of students for 1902–03 is divided among the several classes, as follows: —

Fellows	5
Graduate students, candidates for advanced degrees	12
Regular students, Fourth Year	195
" " Third "	230
" " Second "	278
" " First "	433
Special students	455
Total	1,608

Assigning the special students to classes, according to the predominant studies pursued by them, we reach the following division of the whole body among the several years: —

Class.	Regular.	Special.	Total.
Fellows and Graduates of the M.I.T.	17	—	17
Fourth Year	195	95	290
Third Year	230	130	360
Second Year	278	184	462
First Year	433	46	479
Total	1,153	455	1,608

The Courses of Instruction.

The following table presents the number of the regular students in the second, third, and fourth years, by courses: —

Year.	Civil Engineering.	Mechanical Engineering.	Mining Engineering and Metallurgy.	Architecture.	Chemistry.	Electrical Engineering.	Biology.	Physics.	General Course.	Chemical Engineering.	Sanitary Engineering.	Geology.	Naval Architecture.	Total.
4th Year Class .	31	34	28	13	14	38	1	3	1	10	7	1	14	195
3d " "	42	43	28	17	14	37	—	13	4	6	1	—	25	230
2d " "	56	56	27	13	30	43	1	4	4	14	4	—	26	278
Total	129	133	83	43	58	118	2	20	9	30	12	1	65	703

The following table shows the figures of the total line in the foregoing table, in comparison with the corresponding figures for the next ten preceding years: —

Year.	Civil Engineering.	Mechanical Engineering.	Mining Engineering and Metallurgy.	Architecture.	Chemistry.	Electrical Engineering.	Biology.	Physics.	General Course.	Chemical Engineering.	Sanitary Engineering.	Geology.	Naval Architecture.	Total.
1891	81	104	17	33	23	108	11	5	19	28	9	3	—	441
1892	76	106	19	37	35	112	9	5	16	34	5	3	—	457
1893	78	97	22	50	39	141	4	10	19	31	10	2	8	511
1894	88	111	19	48	50	137	5	9	19	35	13	1	20	556
1895	88	118	25	67	59	126	7	11	14	25	10	3	22	575*
1896	99	117	24	65	66	106	7	11	11	34	8	—	25	573*
1897	109	119	38	71	60	90	8	9	10	36	7	1	26	578
1898	93	108	52	64	64	94	6	8	12	38	7	1	33	574
1899	99	113	60	53	58	84	8	7	11	30	14	1	38	575*
1900	89	127	69	53	50	87	6	4	8	34	17	1	38	582
1901	102	129	76	40	35	96	6	13	9	30	14	1	39	590
1902	129	133	83	43	58	118	2	20	9	30	12	1	65	703

* Deducting those counted twice.

The following table shows, by classes and by courses, the number of regular students who have registered themselves as electing to distribute the required studies and exercises over the period of five years: —

Year.	Total.	Course.												
		I.	II.	III.	IV.	V.	VI.	VII.	VIII.	IX.	X.	XI.	XII.	XIII.
1st . . .	5	–	–	–	–	–	–	–	–	–	–	–	–	–
2d . . .	23	4	10	4	1	–	1	–	1	–	–	–	–	2
3d . . .	14	4	4	–	1	–	3	1	–	–	1	–	–	–
4th . . .	23	4	2	4	–	2	5	–	–	–	1	3	–	2
5th . . .	5	–	1	2	–	1	–	–	–	–	–	1	–	–
	70	12	17	10	2	3	9	1	1	–	2	4	–	4

The following is the number of students, either regular or special, pursuing certain leading branches of study, in each of the four years: —

	First Year.	Second Year.	Third Year.	Fourth Year.	Total.
Mathematics	474	386	175	2	1,037
Chemistry	503	76	117	56	752
English	437	350	24	28	839
French	195	136	55	0	386
Physics	—	397	323	126	846
German	130	269	212	4	615
Mechanic Arts . . .	—	182	84	86	352

The total registration in the Summer School was 214 students; the registration in the various subjects is shown in the following table: —

Mathematics.	
(*a*) Analytic Geometry	14
(*b*) Integral Calculus	5
Applied Mechanics	15
Mechanical Drawing and Descriptive Geometry	42
Mechanic Arts (Shopwork).	
(*a*) Woodwork	8
(*b*) Forging	11
(*c*) Chipping and Filing	5
(*d*) Machine-Tool Work	23
Modern Languages.	
(*a*) French	13
(*b*) German	14
Chemistry.	
(*a*) Inorganic and Analytical Chemistry	46
(*b*) Air, Water, and Food Analysis	3
Physics.	
(*a*) Mechanics, Light, and Electricity	30
(*b*) Heat	5
(*c*) Physical Laboratory	8
Civil Engineering.	
(*a*) Surveying	8
Mechanical Engineering.	
(*a*) Mechanism	8
(*b*) Mechanical Engineering Drawing	8

Residence of Students.

States.	Candidates for Advanced Degrees.	Fourth Year.	Third Year.	Second Year.	First Year.	All Regular Students.	Special Students.	Total.
Alabama	–	–	–	–	–	–	1	1
Arkansas	–	–	–	–	–	–	1	1
California	–	2	4	1	3	10	5	15
Colorado	–	1	–	1	3	5	5	10
Connecticut	–	4	10	8	6	28	15	43
Delaware	–	–	1	2	–	3	1	4
Dist. of Columbia,	–	3	3	4	4	14	3	17
Florida	–	–	–	–	1	1	1	2
Georgia	–	1	–	–	2	3	3	6
Illinois	–	14	12	7	10	43	6	49
Indiana	–	4	1	2	4	11	3	14
Iowa	–	1	2	1	–	4	4	8
Kansas	–	–	–	–	–	–	1	1
Kentucky	–	–	1	5	2	8	3	11
Louisiana	–	1	1	–	–	2	–	2
Maine	–	6		5	11	25	10	35
Maryland	–	2	6	3	5	16	11	27
Massachusetts	15	104	128	167	282	696	239	935
Michigan	–	1	1	–	3	5	5	10
Minnesota	–	2	1	1	2	6	4	10
Missouri	–	1	1	5	4	11	9	20
Montana	–	1	1	–	–	2	1	3
Nebraska	–	1	2	1	1	5	–	5
New Hampshire	–	5	5	7	9	26	8	34
New Jersey	–	–	2	–	6	8	–	8
New Mexico	–	–	–	–	–	–	1	1
New York	1	8	17	20	19	65	31	96
North Carolina	–	1	–	2	–	3	3	6
North Dakota	–	–	–	–	–	–	1	1
Ohio	–	3	6	8	9	26	17	43
Oregon	–	–	–	1	2	3	1	4
Pennsylvania	–	9	3	4	14	30	14	44
Porto Rico	–	–	–	–	1	1	1	2
Rhode Island	–	9	4	5	10	28	12	40
South Carolina	–	–	1	–	–	2	3	1	4
South Dakota	–	–	–	–	1	–	1	1
Tennessee	–	–	1	1	–	–	2	1	3
Texas	–	–	1	2	3	1	7	2	9
Utah	–	–	–	1	1	–	2	–	2
Vermont	–	–	–	3	2	4	9	3	12
Virginia	–	1	–	–	–	1	2	5	7
Washington	–	–	–	2	–	–	2	1	3
Wisconsin	–	1	1	2	3	3	10	1	11
Wyoming	–	–	1	–	–	–	1	–	1
Foreign Countries.								
Australia	–	–	–	–	–	2	2	–	2
Bermuda	–	–	–	–	–	–	–	1	1
Brazil	–	–	1	–	–	2	3	2	5
Chili	–	–	–	–	–	–	–	1	1
China	–	–	–	–	1	–	1	–	1
Cuba	–	–	–	–	1	–	1	1	2
Denmark	–	–	–	–	–	1	1	–	1
England	–	–	–	–	1	–	1	2	3
Germany	–	–	–	1	–	–	1	–	1
Ireland	–	–	–	–	–	–	–	1	1
Japan	–	–	–	–	–	–	–	1	1
Manitoba	–	–	–	–	1	–	1	–	1
Mexico	–	–	–	1	1	2	4	6	10
New Brunswick	–	1	–	–	–	–	1	1	2
Nova Scotia	–	2	2	1	1	–	6	2	8
Ontario	–	–	–	–	1	–	1	1	2
Scotland	–	–	–	–	–	–	–	1	1
Turkey	–	1	–	1	1	–	3	1	4
Total	17	195	230	278	433	1,153	455	1,608	

Forty-one states of the Union and one territory, besides the District of Columbia and Porto Rico, are represented on our list of students. Of the total number of 1,608, 935 are from Massachusetts, or 58 per cent. of the whole; 164 are from other New England states; 509 are from outside New England. Of these, 47 are from foreign countries.

A table showing the number of students in each year, from 1896, coming from each state or territory, and from each foreign country, may be not without interest and instruction: —

States.	1896.	1897.	1898.	1899.	1900.	1901.	1902.
Alabama	1	1	1	–	1	2	1
Arkansas	1	1	–	–	1	1	1
California	9	9	11	9	10	9	15
Colorado	7	8	8	7	8	6	10
Connecticut	24	30	26	29	35	42	43
Delaware	5	6	3	4	4	3	4
Dist. of Columbia	17	13	8	7	13	14	17
Florida	–	1	–	1	1	1	2
Georgia	3	4	4	3	3	4	6
Hawaiian Islands	–	–	1	–	1	–	–
Idaho	1	1	–	–	–	1	–
Illinois	45	40	51	36	39	44	49
Indiana	3	7	3	5	7	11	14
Iowa	14	12	7	6	10	8	8
Kansas	3	3	–	–	–	1	1
Kentucky	12	10	10	4	5	9	11
Louisiana	–	1	1	1	2	1	2
Maine	27	24	19	25	22	30	35
Maryland	9	8	8	8	13	16	27
Massachusetts	730	739	719	731	770	837	935
Michigan	6	5	9	10	8	12	10
Minnesota	7	8	11	10	7	10	10
Missouri	11	6	10	11	13	19	20
Montana	3	5	2	3	5	4	3
Nebraska	2	2	1	3	4	3	5
Nevada	–	–	–	1	1	–	–
New Hampshire	26	25	25	29	26	31	34
New Jersey	13	15	13	12	8	6	8
New Mexico	–	–	–	–	–	–	1
New York	69	62	68	61	68	79	96
North Carolina	1	1	2	2	2	6	6
North Dakota	–	–	–	–	–	–	1
Ohio	28	30	23	27	27	27	43
Oregon	4	3	3	2	1	2	4
Pennsylvania	42	41	34	33	37	36	44
Porto Rico	–	–	–	–	–	1	2
Rhode Island	20	19	23	32	35	38	40
South Carolina	6	4	1	1	1	2	4
South Dakota	–	–	–	1	1	2	1
Tennessee	1	3	3	4	6	4	3
Texas	2	2	1	2	4	7	9
Utah	2	3	5	6	7	7	2
Vermont	7	11	12	12	15	15	12
Virginia	3	4	3	2	3	5	7
Washington	5	4	7	4	2	4	3
West Virginia	2	1	–	1	1	1	–
Wisconsin	6	6	8	7	8	11	11
Wyoming	1	–	–	–	–	–	1
Foreign Countries.							
Australia	–	–	–	–	–	–	2
Austria	–	–	–	–	–	1	–
Bermuda	–	–	–	–	1	2	1
Brazil	–	–	–	–	–	4	5
Cape Breton	–	–	1	–	–	–	–
Chili	1	–	–	–	–	1	1
China	–	–	–	–	–	1	1
Cuba	2	1	1	–	–	1	2
Denmark	–	2	1	1	1	1	1
Du'ch Guiana	–	–	1	1	–	–	–
England	2	2	4	1	3	3	3
France	1	1	1	2	4	1	–
Germany	–	–	1	1	2	3	1
Ireland	–	–	–	–	–	–	1
Jamaica	–	–	–	1	1	1	–
Japan	2	–	1	2	2	2	1
Manitoba	–	–	–	–	–	–	1
Mexico	3	6	7	7	7	7	10
New Brunswick	2	2	3	3	2	2	2
Nova Scotia	1	1	2	–	2	6	8
Ontario	2	–	–	–	–	3	2
Quebec	2	2	1	3	4	2	–
Russia	–	–	–	1	1	1	–
Scotland	–	–	–	–	–	–	1
Turkey	1	3	3	3	3	1	4
Total	1,198	1,198	1,171	1,178	1,277	1,415	1,608

Residence of Massachusetts Students.

It has been said that 58 per cent. of our students are from Massachusetts. All the counties of the State except Dukes send students to the Institute. One hundred and forty-six cities and towns are on the lists. The first column

of the following table shows the number of cities and towns in each county sending pupils: the second column gives the aggregate number from each county. It appears that Suffolk sends two hundred and seventy-eight, and Middlesex two hundred and seventy-three pupils; Essex comes third, with one hundred and thirty-five; Norfolk, fourth, with ninety-seven.

County.	No. of Towns.	No. of Students.	County.	No. of Towns.	No. of Students.
Barnstable	5	9	Middlesex	32	273
Berkshire	4	9	Nantucket	1	1
Bristol	11	33	Norfolk	21	97
Essex	24	135	Plymouth	19	42
Franklin	3	5	Suffolk	4	218
Hampden	5	16	Worcester	15	32
Hampshire	3	5			
			Total	146	935

The following is a list of the towns, forty-three in number, which send five or more students to the Institute: —

Boston	261	Haverhill	12	Beverly	7
Newton	49	Melrose	12	Springfield	7
Cambridge	33	Brockton	11	Wenham	7
Somerville	22	Taunton	11	Concord	6
Newburyport	21	Fitchburg	10	Marlboro	6
Brookline	20	Quincy	10	Natick	6
Salem	19	Canton	9	Reading	6
Lawrence	18	Chelsea	9	Stoneham	6
Lowell	18	New Bedford	9	Woburn	6
Lynn	16	Winchester	9	Andover	5
Framingham	14	Gloucester	8	Holyoke	5
Malden	14	Weymouth	8	Middleboro	5
Hyde Park	13	Arlington	7	Peabody	5
Medford	13	Belmont	7	Plymouth	5
Waltham	13				

The following table exhibits for ten years the distribution of the total number of students among two classes: first, those students whose names are found upon the Catalogue of the year preceding; and, secondly, those whose names

appear first upon the Catalogue of the year to which the statement relates.

Year.	(1) Total No. of Students.	(2) No. of Students in the catalogue of the previous year who remain in the Institute.	(3) No. of New Students entering before issue of catalogue.	(4) Of those in column (3) the following number are regular First-year Students.	(5) No. of New Students not of the regular First-year Class.
1892–93	1,060	618	442	303	139
1893–94	1,157	701	456	301	155
1894–95	1,183	768	415	271	144
1895–96	1,187	778	409	266	143
1896–97	1,198	758	440	263	177
1897–98	1,198	757	441	277	164
1898–99	1,171	769	402	278	124
1899–1900	1,178	764	414	275	139
1900–1901	1,277	789	488	312	176
1901–1902	1,415	844	571	396	175
1902–1903	1,608	949	659	432	226

Ages of Students.

The next table exhibits the ages of our students upon entrance, after taking out one who is repeating the first year, and fifteen persons of unusual ages. These deductions leave four hundred and seventeen as the number of students whose ages have been made the subject of computation.

Period of Life.	1901–1902.		1902–1903.	
	Half-year Groups.	Yearly Groups.	Half-year Groups.	Yearly Groups.
16 to 16½ years	—	—	3	—
16½ to 17 "	4	4	12	15
17 to 17½ "	28	—	30	—
17½ to 18 "	48	76	49	79
18 to 18½ "	47	—	85	—
18½ to 19 "	66	113	65	150
19 to 19½ "	73	—	65	—
19½ to 20 "	41	114	47	112
20 to 20½ "	31	—	28	—
20½ to 21 "	24	55	10	38
21 to 22 "	15	15	23	23
	377	377	417	417

The results appear in the table above in comparison with the corresponding results of 1901–1902.

From the foregoing it appears that the average age on entrance is eighteen years and ten months.

In this connection are presented the ages, at graduation, of the class which left us in June. The one hundred and ninety-three members of the class were distributed among the different periods of life as follows: —

Under 20½	2
Between 20½ and 21	8
" 21 " 21½	16
" 21½ " 22	32
" 22 " 23	54
" 23 " 24	42
" 24 and over	39
Total	193

The special students this year constitute twenty-eight per cent. of the whole body, as against twenty-nine per cent. last year and twenty-seven per cent. the year before.

Graduate Students.

The number of students who are graduates of this and other institutions is one hundred and sixty-one. Of these twelve are candidates for advanced degrees, ten being our own graduates.

One hundred and fifty-one are graduates of the following institutions, and are pursuing courses of study with us either as regular or as special students.

Universities.

Acadia	1	Leland Stanford, Jr.	2
Baylor	1	Maine	1
Boston	2	Miami	1
Brown	4	Northwestern	3
Catholic University of America	1	Pennsylvania	2
Chicago	4	Princeton	3
Colgate	1	Rochester	1
Cornell	3	Tulane	1
Hamline	1	University of the South	1
Harvard	12	Vermont	2
Illinois	2	Virginia	2
Johns Hopkins	4	Washington	1
Kansas State	1	Yale	12
Lake Forest	1		70

Colleges.

Acadia	1	Pennsylvania Military	1
Adelbert	1	Pomona	1
Amherst	4	Radcliffe	1
Bates	1	Randolph-Macon	1
Beloit	3	Rhode Island Agricultural	1
Boston	3	Robert	1
Butler	1	Rock Hill	1
Canisius	1	St. Francis Xavier	1
Central	1	St. Ignatius	1
Christian Brothers	1	St. Joseph	1
City of New York	2	St. Xavier	1
Colby	2	Smith	1
Colorado	1	Southwest Baptist	1
Connecticut Agricultural	1	Southwestern Presbyterian	2
Davidson	2	Syrian Protestant	1
Delaware	1	Texas Agricultural	2
Detroit	1	Throop Polytechnic Institute	1
Earlham	1	Trinity	3
Gallaudet	1	Tufts	2
Georgetown	1	U.S. Naval Academy	6
Grove City	1	Vassar	1
Haverford	1	Villanova	1
Iowa	1	Virginia Medical	1
Kalamazoo	1	Virginia Military	1
Kenyon	1	Wellesley	3
Mass. College of Pharmacy	1	Westminster	1
Mass. Inst. of Technology	10	Williams	1
Milton	1	Winchester Normal	1
Mt. Allison	1	Wittenberg	1
Mt. St. Joseph	1		94
Munich Technical Institute	1		
North Dakota Agricultural	1	Total	164
Neuchâtel Académie	1	Deduct names counted twice	3
Oberlin	1		161

Women Students.

The number of women pursuing courses with us is sixty-three. Of these four are graduates of colleges. Of the total number seven are regular students of the fourth year, five of the third year, five of the first year. Forty-six are special students. Of the twelve regular students of the upper classes, five take Course IV., Architecture; three, Course V., Chemistry; one, Course VII., Biology; two, Course VIII., Physics; and one, Course IX., General Studies. Of the special students, thirty devote themselves to biology, three to chemistry, three to physics, two to architecture, one to general studies, one to naval architecture, and one to mechanical engineering, while five are first-year specials.

Statistics of Admission.

Of the 1,608 students of the present year, 659 were not connected with the school in 1901–1902. Of these 408 were admitted as regular students of the first year upon the basis of their entrance examinations. The 251 remaining comprise (1) those who had previously been connected with the Institute, and have resumed their places in the school; (2) those who were admitted provisionally without examination; (3) those who were admitted by examination as regular second-year or as special students; (4) those who were admitted on the presentation of diplomas or certificates from other institutions of college grade or from the College Examination Board. In addition to the 408 who were thus admitted to the first year on examination, and have taken their place in the school, 70 were admitted on examination, but have not entered the school.

In the case of the 408 persons who were admitted on examination, and have joined the school, the results of the examinations, embracing both those of June and those of September, were as follows: —

Admitted clear	316
" on one condition	75
" on two conditions	17
	408

One hundred and four applicants were rejected.

Entrance Examinations at Distant Points.

In addition to the entrance examinations held at Boston in July and September, examinations were conducted in July at Austin (Tex.), Belmont (Cal.), Chicago, Denver, Detroit, Kansas City (Mo.)., New York, North Adams, Philadelphia, Pittsburg, Portland (Me.), St. Louis, St. Paul, Springfield (Mass.), Syracuse, and Washington.

Graduates by Courses.

The following table exhibits the number of persons who have graduated within each of the several courses since the foundation of the school: —

Year.	Civil Engineering.	Mechanical Engineering.	Mining Engineering.	Architecture.	Chemistry.	Metallurgy.	Electrical Engineering.	Natural History or Biology.	Physics.	General Course.	Chemical Engineering.	Sanitary Engineering.	Geology.	Naval Architecture.	Total.
1868	6	1	6	–	–	–	–	–	–	1	–	–	–	–	14
1869	2	2	–	–	1	–	–	–	–	–	–	–	–	–	5
1870	4	2	2	–	1	–	–	–	–	1	–	–	–	–	10
1871	8	2	5	–	2	–	–	–	–	–	–	–	–	–	17
1872	3	1	5	–	3	–	–	–	–	–	–	–	–	–	12
1873	12	2	3	1	7	–	–	–	–	1	–	–	–	–	26
1874	10	4	1	1	–	–	–	–	–	2	–	–	–	–	18
1875	10	7	6	1	1	–	–	–	1	2	–	–	–	–	28
1876	12	8	7	–	5	1	–	2	3	4	–	–	–	–	42
1877	12	6	8	4	2	–	–	–	–	–	–	–	–	–	32
1878	8	2	2	3	3	–	–	–	–	1	–	–	–	–	19
1879	6	8	3	1	3	–	–	1	1	–	–	–	–	–	23
1880	3	–	3	–	1	–	–	–	–	1	–	–	–	–	8
1881	3	5	6	3	8	–	–	1	–	2	–	–	–	–	28
1882	2	5	5	3	6	–	–	1	1	1	–	–	–	–	24
1883	3	7	5	1	3	–	–	–	–	–	–	–	–	–	19
1884	5	6	13	–	12	–	–	–	–	–	–	–	–	–	36
1885	4	7	8	2	4	–	2	–	–	1	–	–	–	–	28
1886	9	23	7	1	7	–	10	1	–	1	–	–	–	–	59
1887	10	17	8	1	9	–	8	1	1	3	–	–	–	–	58
1888	11	25	4	5	10	–	17	3	1	1	–	–	–	–	77
1889	14	24	5	3	8	–	17	1	1	2	–	–	–	–	75
1890	25	28	3	5	13	–	18	3	2	6	–	–	–	–	103
1891	18	26	4	6	11	–	23	3	3	1	7	–	1	–	103
1892	22	26	4	13	7	–	36	6	1	7	4	6	1	–	133
1893	25	30	5	2	8	–	41	2	–	6	8	–	2	–	129
1894	21	31	4	14	11	–	33	1	3	5	12	3	–	–	138
1895	25	30	3	15	14	–	33	–	2	4	11	4	–	5	144*
1896	25	34	10	24	17	–	48	3	3	7	7	4	3	5	189*
1897	25	40	7	16	20	–	33	2	3	7	12	4	1	9	179
1898	32	41	7	29	25	–	33	3	4	6	9	3	–	7	199
1899	30	37	9	22	21	–	32	2	2	1	10	1	–	8	173*
1900	32	34	21	21	19	–	23	3	3	5	11	4	–	9	185
1901	37	39	17	21	17	–	25	1	1	6	14	4	1	16	199
1902	24	46	15	18	14	–	35	5	3	3	9	7	–	14	193
Totals	498	606	221	236	293	1	467	45	39	88	114	40	9	73	2,725*
Deduct names counted twice															15
Net total															2,710

* Deducting names counted twice.

THE SOCIETY OF ARTS.

Report of the Secretary.

To the President of the Institute:

Sir: — On behalf of the Executive Committee I have the honor to present the annual report of the Society of Arts for the year May 16, 1901, to May 8, 1902.

The first meeting of the Society for the present year was held on October 10, 1901. Fourteen meetings have been held with an average attendance of 216. During the last three years there has been a steady gain in the attendance, which has reached this year three times that of any corresponding period since 1875. Another feature, most gratifying to the Executive Committee, is the increased interest manifested by the students of the Institute in these meetings.

The following papers have been read: —

"The Olympia: A general Description of this famous Ship, and a Discussion of the Development of Cruisers during the Past and the Tendency to Future Progress." NAVAL CONSTRUCTOR WILLIAM J. BAXTER, U.S.N.

"Present Condition of American Railroads as Compared with the Period of Depression 1893–1897." PROFESSOR WILLIAM Z. RIPLEY, Expert Agent on Transportation, U.S. Industrial Commission.

"The Importance of Catalytic Agents in Chemical Processes." PROFESSOR ARTHUR A. NOYES.

"The Development of the Nernst Lamp in America." MR. ALEXANDER J. WURTS, Manager, Nernst Lamp Company.

"The Development of Locomotive Boilers with Particular Reference to the Vanderbilt Boilers." MR. CORNELIUS VANDERBILT.

"The New Star in Perseus." PROFESSOR GEORGE E. HALE, Director, Yerkes Observatory.

"The Utilization of Electricity in Mines." MR. CALVIN W. RICE, Electrician, New York Edison Company.

"Some Features of the Isthmian Canal Question." PROFESSOR W. H. BURR, Member of the U.S. Commission on the Isthmian Canal.

"Engineering in China." MR. WILLIAM BARCLAY PARSONS, Chief Engineer, New York Subway.

"Aluminum as a Reducing and a Heat-Producing Agent." PROFESSOR HEINRICH O. HOFMAN.

"India Rubber: A Description of the Crude Gum and its Manufacture." MR. WALTER E. PIPER, Assistant Superintendent, Boston Rubber Shoe Company.

"Smoke and its Abatement in Large Cities." PROFESSOR C. H. BENJAMIN, Supervising Engineer, City of Cleveland, Ohio.

"A Trip through Siberia." HON. E. J. HILL, Member of U.S. House of Representatives.

"Success in Long Distance Power Transmissions." DR. F. A. C. PERRINE, President of the Stanley Electric Manufacturing Company.

At the beginning of the year, the Associate Membership was three hundred and fifty-four. Of these members one has died, five have resigned, one has been cancelled, and twenty-two have been elected, making the present membership three hundred and sixty-nine. There are thirty-eight Associate Life Members.

The publication of the Technology Quarterly has been continued, as before, under the auspices of the Society of Arts. There has been a regrettable difficulty in obtaining manuscripts of papers read before the Society. Nevertheless, the Quarterly has not lacked material, and has published contributions from a considerable number of the Departments of the School. One of the most notable of these contributions is "The Report of the Massachusetts Institute of Technology Eclipse Expedition to Sumatra in 1901" by Professor Burton and Messrs. H. M. Smith, G. L. Hosmer, and G. H. Matthes Another important contribution from the Civil Engineering Department is "Tests of the Massachusetts Institute of Technology Tape Apparatus," by Professors Burton and Mr. John F. Hayford of the U.S. Coast and Geodetic Survey. The Mechanical Engineering Department contributed the usual quota of "Results of Tests," during the summer, and also a paper by Mr. J. C. Riley on the "Pulsometer Steam Pump." From the Physical Department there was a paper by Professor Laws on "An Apparatus for Recording Alternating Current Waves," and one by him and Dr. Coolidge on "An Apparatus for the Rapid Comparison of Voltmeters." The Chemical Department has furnished three: — "Contributions from the Laboratory of Sanitary Chemistry" by Mrs.

Richards, Mr. Woodman, and Miss Hyams; a paper by Professor Gill and Mr. Healey on "Some Thermal Properties of Naphthas and Kerosenes"; and the "Review of American Chemical Research," edited by Professor Noyes, to December. It was found impracticable for the Chemical Department to continue the preparation of the Review and its publication was discontinued with the issue of the December number of the Quarterly. Mr. Winslow has contributed from the Biological Department a report on "Typhoid Fever at Newport, R.I., in 1900 and its relation to Defective Sanitation," and we have had from Mr. Prescott a paper "On the Application of Bacteriology to certain Arts and Industries." The contributions from the Geological Department are two papers by Professor Crosby, one on "Tripolite Deposits of FitzGerald Lake" and the other on the "Geological History of the Hematite Iron Ores of the Anthwerp and Fowler Belt in New York;" and Mr. F. G. Clapp's thesis on the "Geological History of the Charles River." Messrs. Whipple and Jackson have continued their important series of papers on methods of water examination, and Mr. William Lincoln Smith has furnished a second part of his valuable "Study of Certain Shades and Globes for Electric Lights as used in Interior Illumination."

At the last meeting of the year, the fortieth annual meeting, Messrs. George W. Blodgett, Desmond FitzGerald, Edmund H. Hewins, Charles T. Main, and James P. Munroe were re-elected members of the Executive Committee, and Mr. George V. Wendell was re-elected Secretary for the year 1902–1903.

At the October meeting, 1902, the resignation of Mr. Wendell was received and Mr. James F. Norris was elected Secretary.

Respectfully submitted,

JAMES F. NORRIS,
Secretary.

JANUARY 26, 1903.

GENERAL STATEMENT

OF THE

RECEIPTS AND DISBURSEMENTS BY THE TREASURER

FOR THE YEAR ENDING SEPT. 30, 1902

STATEMENT OF THE TREASURER.

The Treasurer submits the annual statement of the financial affairs of the Institute for the year ending Sept. 30, 1902.

This year there has again been a large increase in the amount received from students' fees, the total being more than $31,000 greater than a year ago; but with the increase in the number of students has come a corresponding growth in the expenses, so that the excess of current expenses over receipts is $5,892.14. A year ago such excess was $9,590.26. In other words, the total increase in receipts for current expenses has been somewhat over $35,000, and the increase in expenses between $31,000 and $32,000 over those of a year ago, making the annual deficit nearly $4,000 less.

A triangular piece of land containing about forty-six hundred square feet and adjoining that previously owned on Stanhope Street, has been purchased in order to bring the front of our land to the future line of Clarendon Street extended.

The new Augustus Lowell Laboratory of Electrical Engineering, covering nearly an acre of ground, was begun July 1. All the work included in the original contract was completed September 17, so that the laboratory was ready for use at the beginning of the new term. The portion of the cost of this new building paid during the financial year was $69,705.12. The very large increase in the number of students has made this building an absolute necessity.

A valuable tract of land in Brookline, near Jamaica Pond, and comprising between eleven and twelve acres, has been bought, the total cost being about $113,000. This purchase makes possible certain much needed extensions of the Institute's work as soon as the necessary funds can be secured.

The following legacies and gifts have been received: —

From Samuel Cabot, Esq., $20,000 to be applied toward the purchase of the above Brookline land.

From A. Lawrence Lowell, Esq., and Percival Lowell, Esq., from each $10,000 toward the erection of the Augustus Lowell Laboratory of Electrical Engineering, and from Mrs. W. Scott Fitz $2,000 for the same object.

From the Robert C. Billings estate an additional sum of $7,500, being the amount of the United States inheritance tax returned by the government.

From G. W. Armstrong, Esq., in memory of his son George Robert Armstrong, $5,000, to be known as the George Robert Armstrong Fund.

From an unnamed donor, through President Pritchett, $5,000 to be used "in experiments with a view of finding out the cheapest and most efficacious way of purifying sewage before it is poured into the rivers and harbors of our country." The giver of this promises an equal amount yearly for two more years, for similar purposes.

From Arthur T. Lyman, Esq., $5,000 for general purposes.

From a friend, through Francis H. Williams, M.D., $1,000 for experiments in the use of the Roentgen-rays.

From the estate of the late Henry L. Pierce, an additional sum of $3,000.

From the estate of the late Susan E. Dorr, an additional sum of $1,956.63.

From the estate of the late Matilda Goddard, $500.

From the Saturday Club, for the purchase of books, $500.

From a friend, for salary account, $500.

From Mrs. William B. Rogers, for the purchase of periodicals, $200.

From Samuel Cabot, Esq., for prizes for designs for medal to be given for improvement in physical development, $25.

The gifts and bequests during the past year to be added to the funds for special purposes amount to $46,951.05, and to the funds for general purposes to $21,000 (page 4). These figures do not include the money given for sewage experiments and for Roentgen-ray investigation, nor $1,225 given to be used during the past year.

The total increase in the funds of the Institute for this year has been $96,524.18, including $26,558.97 cash belonging to the Walker Memorial Fund.

The investments of the Walker Memorial Fund have not been included in the general account of the Institute, but the total amount actually paid into that fund up to the close of the financial year was $68,960, which, together with accumulated interest thereon, makes a total of $71,347.30.

Securities Sold or Paid, General Account.

$2,000	Bur. & Mo. River (Neb.) R.R. 6s	1918	2,000.00
19,000	Walter Baker Co. Lt'd. 4½s	1903	19,000.00
3,000	Ozark Equipment Co. 5s.	1910	3,000.00
10	Shares Lowell Bleachery		260.00
55	" Old Boston National Bank		6,160.00
15	" Merchants " "		2,926.50
25	" New England " "		4,000.00
25	" Atlantic " "		3,325.00
37	" Nat. Mechanics Bank, Baltimore		1,147.00
			$41,818.50

Securities Bought, General Account.

$50,000	N. Pac. Great Northern R.R. Joint 4s	1921	$48,500.00

GEORGE WIGGLESWORTH, TREASURER, *in account with*
GENERAL STATEMENT OF RECEIPTS AND DISBURSEMENTS

Dr.

Cash balance, Sept. 30, 1901		28,638.07
From A. Lawrence Lowell for Lowell Institute Courses		5,757.15
RECEIPTS FOR CURRENT EXPENSES.		
Income of funds for salaries	4,324.00	
" " " " scholarships (students' fees),	10,175.00	
" " " " Joy "	200.00	
" " " " Swett "	400.00	
" " " " Savage "	400.00	
" " " " W. B. Rogers	600.00	
" " " " Library	480.00	
" " " " general purposes	27,976.52	
" " Rogers Memorial Fund	10,838.00	
" " Charlotte B. Richardson Fund	1,495.15	
" " Rotch Prize Funds	400.00	
" " Rotch Architectural Fund	1,000.00	
" " Edward Austin Fund, Scholarships	7,500.00	
" " " " " Awards	5,385.00	
" " Teachers' Fund	3,800.00	
Letter Box Fund	50.00	
Students' fees	252,987.75	
State Scholarships	4,000.00	
United States Act of 1862	5,501.68	
United States Act of 1890	8,333.34	
Gift of State of Massachusetts	25,000.00	
Laboratory supplies and breakages	11,794.01	
Rents, per Table (page 12)	5,982.80	
Gifts	1,225.00	
Interest	8,920.91	
Boston University	1,150.00	
Sale Printed Lecture Notes	3,218.10	403,137.26
GIFTS AND BEQUESTS FOR SPECIAL PURPOSES.		
Increase Scholarship Funds	1,279.42	
" Teachers' Fund	200.00	
" Edward Austin Fund	1,515.00	
" Susan E. Dorr Fund, additional	1,956.63	
Aug. Lowell Lab. Electrical Eng. Fund, add'l,	22,000.00	
Samuel Cabot, toward Brookline land purchase	20,000.00	46,951.05
GIFTS AND BEQUESTS FOR GENERAL PURPOSES.		
Henry L. Pierce Legacy, additional	3,000.00	
Matilda Goddard Legacy	500.00	
R. C. Billings Legacy, tax refunded	7,500.00	
George Robert Armstrong Fund	5,000.00	
Arthur T. Lyman Fund	5,000.00	21,000.00
SECURITIES SOLD OR PAID.		
General Fund, page 3		41,818.50
SUNDRIES.		
Income credited to Bond Premium Acc't	4,622.25	
" " " Rogers Bond Premium Acc't,	825.00	
Boston Art Students' Association, on acc't	666.67	
Notes receivable paid	100,000.00	
Students' Deposits	250.00	
Walker Memorial Fund	40,747.30	
Roentgen-Ray Experiment Fund	1,000.00	
Sewage Experiment Fund	5,000.00	153,111.22
		$700,413.25

MASSACHUSETTS INSTITUTE OF TECHNOLOGY.

FOR THE YEAR ENDING SEPT. 30, 1902.

Cr.

Paid for Lowell Institute Courses		5,757.15

EXPENSES.

Salaries, per Table (page 12)	291,501.29	
" paid from Gifts	500.00	
Fellowship paid from Swett Fund	400.00	
" " " Savage "	400.00	
Edward Austin Fund, Awards	5,385.00	
Teachers' Fund, "	3,800.00	
Prizes, Rotch Funds	400.00	
Prizes, Athletic Medal Designs	25.00	
Repairs, per Table (13)	13,648.76	
General Expenses, per Table (page 13)	17,661.78	
Fire Insurance	2,063.21	
Fuel	10,428.98	
Water	2,866.35	
Gas	2,452.10	
Electricity	1,901.36	
Printing and Advertising	5,909.34	
" Lecture Notes	2,891.19	
" Annual Catalogues and Reports	3,676.65	
Rents paid Boston & Albany R.R. Co.	90.00	
" " Natural History Society	200.00	
" " 71 Newbury Street	1,493.63	
Laboratory Supplies and Libraries, per Table (p. 12)	39,903.27	
Society of Arts	1,408.94	
Pan-American Exposition	22.55	409,029.40

(Expenses more than Income, $5,892.14)

SECURITIES BOUGHT OR RECEIVED AS LEGACIES.

General Account (page 3)		48,500.00
Walker Memorial Fund		13,000.00

SUNDRIES.

Extension Lot, No. 3 Trinity Place	23,210.00	
Aug. Lowell Lab. Electrical Eng. Bldg., 1902	69,705.12	
Brookline Real Estate	112,904.32	205,819.44
Cash balance, Sept. 30, 1902		18,307.26
		$700,413.25

The following account exhibits the property held by the Institute, as per Treasurer's books, Sept. 30, 1902:—

INVESTMENT OF THE W. B. ROGERS MEMORIAL FUND.

30,000.00	Burlington & Mo. River R.R. 4s.	1910	25,787.50	
27,000.00	Kansas City Belt R.R. 6s.	1916	27,000.00	
6,000.00	New York & New England R.R. 6s.	1905	6,000.00	
3,800.00	Republican Valley R.R. 6s.	1919	3,800.00	
4,000.00	Cin., Ind., St. Louis & Chicago R.R. 6s.	1920	4,000.00	
4,000.00	Kansas City, Fort Scott & Gulf R.R. 7s.	1908	4,000.00	
1,000.00	Lincoln & Northwestern R.R. 7s.	1910	1,000.00	
1,000.00	Atchison & Nebraska R.R. 7s.	1908	1,000.00	
35,000.00	Fort Street Union Depot 4½s.	1941	34,825.00	
24,000.00	Rome, Watertown & Ogdensburg R.R. 5s.	1922	24,000.00	
37,500.00	Detroit, G. Rapids & Western R.R. 4s.	1946	37,500.00	
25,000.00	Atchison, Top. & St. Fé R.R. 4s.	1995	24,470.00	
7,000.00	Chesapeake & Ohio R.R. 5s.	1939	7,000.00	
38,000.00	Chi. Junc. & Union Stock Yards 5s.	1915	38,000.00	
3,000.00	Chi., Mil. & St. Paul R.R. 7s.	1905	3,000.00	
	Advances to Bond Premium acc't		9,207.50	
				250,590.00

INVESTMENTS, GENERAL ACCOUNT.

8,000.00	Bur. & Mo. River (Neb.) R.R. 6s., non-exempt	1918	8,000.00	
2,000.00	Bur. & Mo. River (Neb.) R.R. 6s., exempt	1918	2,000.00	
5,000.00	Chicago, Burlington & Quincy R.R 4s.	1922	4,100.00	
3,000.00	Hannibal & St. Joseph R.R. 6s.	1911	3,000.00	
6,000.00	West End Street Ry. 5s.	1902	6,000.00	
35,000.00	Fitchburg R.R. 5s.	1903	35,000.00	
65,000.00	Boston & Maine R.R. 4½s.	1944	65,000.00	
26,000.00	Am. Dock & Improvement Co. 5s.	1921	26,000.00	
3,000.00	Illinois Central R.R. 4s.	1951	3,000.00	
26,000.00	New York & New England R.R. 6s.	1905	26,000.00	
8,000.00	Chi. Junc. & Union S. Yards 5s.	1915	8,000.00	
5,000.00	Dominion Coal Co. 1st. 6s.	1913	5,000.00	
2,000.00	New England Tel. & Tel. Co. 6s.	1907	2,000.00	
2,000.00	New York & New England R.R. 7s.	1905	2,000.00	
100,000.00	West End Street Ry. 4s.	1917	100,000.00	
50,000.00	Utah & Northern R.R. 1st 7s.	1908	50,000.00	
47,000.00	Walter Baker Co., Ltd., 4½s.	1903	47,000.00	
50,000.00	Chi. Terminal & Transfer Co. 1st 4s.	1947	47,507.50	
120,000.00	Illinois Steel Co., non-conv. 5s.	1913	119,586.25	
43,000.00	Chesapeake & Ohio R.R. 5s.	1939	43,000.00	
100,000.00	Long Island R.R. 4s.	1949	96,137.50	
7,000.00	K. C., Clinton & Springfield R.R. 5s.	1925	6,289.21	
8,500.00	K. C., Mem. & Birmingham R.R. 4s.	1934	8,287.50	
13,000.00	K. C., St. Jo. & Council Bluffs R.R. 7s.	1907	13,000.00	
50,000.00	Kansas City Stock Yards 5s.	1910	50,000.00	
25,000.00	Atchison, Top. & St. Fé R.R. 4s.	1995	25,000.00	
50,000.00	Rio Grande & Western R.R. 4s.	1939	49,180.00	
50,000.00	Oregon R.R. & Navigation Co. 4s.	1946	50,000.00	
50,000.00	Union Pacific R.R. 4s.	1947	50,000.00	
100,000.00	Chic. & W. Michigan R.R. 5s.	1921	100,000.00	
100,000.00	American Tel. & Tel. Co. 4s.	1929	99,875.00	
50,000.00	New England Tel. & Tel. Co. 4s.	1930	50,000.00	
50,000.00	Chi. Junc. & Union S. Yards 4s.	1940	49,250.00	
50,000.00	K. C., Fort Scott & Memphis R.R. 6s.	1928	50,000.00	
25,000.00	Southern Ry., St. Louis Div. 4s.	1951	24,875.00	
22,000.00	Ozark Equipment Co. 5s.	1910	22,000.00	
50,000.00	Northern Pac. Gt. Northern Joint 4s.	1921	48,500.00	
	Advances to Bond Premium acc't		40,210.00	
				1,434,797.96
	Amount carried up			$1,685,387.96

	Amount brought up				$1,685,387.96

STOCKS.

Shares.					
172	Boston & Albany R.R.	par	100	34,456.50	
50	Chi., Milwaukee & St. Paul R.R. Pf.	"	100	6,775.00	
12	Cocheco Manufacturing Co.	"	500	6,000.00	
56	Hamilton Woollen Co.	"	100	5,390.00	
31	Great Falls Manufacturing Co.	"	100	3,472.00	
2	Dwight Manufacturing Co.	"	500	1,600.00	
17	Pepperell Manufacturing Co.	"	100	2,789.50	
27	Essex Co.	"	50	3,780.00	
25	National Bank of the Republic	"	100	3,625.00	
40	The Molsons Bank, Montreal	"	50	2,930.00	
64	Boston Real Estate Trust	"	1000	68,909.64	
1	Boston Ground Rent Trust	"	1000	900.00	140,627.64

INVESTMENT OF THE JOY SCHOLARSHIP FUND.

Massachusetts Hospital Life Insurance Co. .	5,000.00		
Deposits in Savings Banks	4,123.70		9,123.70

INVESTMENT SWETT SCHOLARSHIP FUND.

Massachusetts Hospital Life Insurance Co.		10,000.00
Amount carried up		$1,845,139.30

Amount brought up			$1,845,139.30

REAL ESTATE.

Rogers Building		200,000.00	
Walker "		150,000.00	
Land on Garrison Street	50,840.00		
Workshops " "	30,000.00	80,840.00	
Land on Trinity Place	76,315.69		
Engineering B'ld'g, A, Trinity Place,	90,000.00	166,315.69	
Gymnasium Building		7,967.85	
Engineering Building, B		57,857.10	
Lot No. 2, Trinity Place		137,241.60	
Lot No. 3, " "		282,260.00	
Henry L. Pierce Building, Trinity Place		154,297.05	
Boiler and Power House, " "		26,916.74	
Clarendon St. Land and Building		142,762.94	
Real Estate, Massachusetts Ave., Cambridge		16,154.38	
Real Estate, Brookline, Mass.		112,904.32	
Aug. Lowell Lab. Elec. Eng. Bldg., 1902		69,705.12	1,605,222.79
Equipment, Engineering Building		16,555.24	
" Workshops		20,628.56	37,183.80

SUNDRIES.

Notes Receivable		37,000.00	
Boston Art Students' Association		8,999.99	
Students' Notes		770.50	
Cash Balance, Sept. 30, 1902		18,307.26	65,077.75
			$3,552,623.64

The foregoing property represents the following Funds and Balances, and is answerable for the same.

The income of the following is used for the general purposes of the Institute: —

William Barton Rogers Memorial Fund	250,225.00	
Richard Perkins Fund	50,000.00	
George Bucknam Dorr Fund	49,573.47	
Martha Ann Edwards "	30,000.00	
Nathaniel C. Nash "	10,000.00	
Sidney Bartlett "	10,000.00	
Robert E. Rogers "	7,680.77	
Albion K. P. Welch "	5,000.00	
Stanton Blake "	5,000.00	
McGregor "	2,500.00	
Katharine B. Lowell "	5,000.00	
Samuel E. Sawyer "	4,764.40	
John W. and Belinda Randall Fund	83,452.36	
James Fund	163,654.21	
George Robert Armstrong Fund	5,000.00	
Arthur T. Lyman Fund	5,000.00	686,850.21
Amount carried up		$686,850.21

Amount brought up		$686,850.21
The income of the following is used towards paying salaries: —		
Nathaniel Thayer, for Professorship of Physics	25,000.00	
Jas. Hayward, for Professorship of Engineering	18,800.00	
William P. Mason, " " Geology	18,800.00	
Henry B. Rogers, for general salaries	25,000.00	
George A. Gardner, " "	20,000.00	
Sarah H. Forbes, "	500.00	108,100.00
SCHOLARSHIP TRUSTS.		
Richard Perkins Fund	53,267.74	
James Savage "	14,137.87	
Susan H. Swett "	10,182.95	
William Barton Rogers Fund	10,717.89	
Joy Fund	9,123.70	
Elisha Thatcher Loring Fund	5,356.27	
Charles Lewis Flint "	5,274.65	
Thomas Sherwin "	5,000.00	
Farnsworth "	5,000.00	
James H. Mirrlees "	2,828.30	
William F. Huntington "	5,225.32	
T. Sterry Hunt "	3,229.33	
Elisha Atkins "	5,000.00	
Nichols "	5,000.00	
Ann White Vose "	60,778.15	
Ann White Dickinson "	40,642.92	
Dalton Grad. Chemical "	6,471.44	
Willard B. Perkins "	7,112.75	
Billings Student "	50,000.00	
Henry Saltonstall "	10,000.00	314,349.28
OTHER TRUSTS.		
Charlotte Billings Richardson Ind. Chem. Fund		37,378.78
Susan Upham Fund		1,299.54
Susan E. Dorr "		12,956.63
William Hall Kerr Library Fund		2,000.00
Charles Lewis Flint " "		5,000.00
Rotch Architectural " "		5,000.00
Rotch Architectural Fund		25,000.00
Rotch Prize "		5,200.00
Rotch "Special" Prize Fund		5,200.00
Edward Austin "		366,549.09
Teachers' "		104,000.00
Saltonstall "		40,600.00
Letter Box "		10.50
MISCELLANEOUS.		
Students' Deposits	450.00	
Henry L. Pierce Legacy, 1898	803,000.00	
Robert C. Billings Legacy, 1900	100,000.00	
Rebecca A. Goddard " 1901	1,000.00	
Barthold Schlesinger " 1901	2,000.00	
Matilda Goddard " 1901	500.00	
Aug. Lowell Lab. Electrical Eng. Fund	32,000.00	
Walker Memorial Fund	26,558.97	
Samuel Cabot, Gift Brookline Land Account	20,000.00	
Roèntgen-Ray Experiment Fund	1,000.00	
Sewage Experiment Fund	5,000.00	
M. I. T. Stock Account	841,620.64	1,833,129.61
		$3,552,623.64

Comparative Statement of Funds, etc.

	Sept. 30, 1901.	Sept. 30, 1902.
Trusts for general purposes	676,850.21	686,850.21
" " Salaries	108,100.00	108,100.00
" " Scholarships	313,482.26	314,349.28
" " Library	7,000.00	7,000.00
Charlotte B. Richardson Ind. Chem. Fund	37,378.78	37,378.78
Susan Upham Fund	1,297.64	1,299.54
Susan E. Dorr "	11,000.00	12,956.63
Rotch Architectural Library Fund	5,000.00	5,000.00
Rotch Architectural Fund	25,000.00	25,000.00
Rotch Prize Fund	5,200.00	5,200.00
Rotch "Special" Prize Fund	5,200.00	5,200.00
Henry L. Pierce Legacy	800,000.00	803,000.00
Robert C. Billings "	92,500.00	100,000.00
Saltonstall Fund	40,200.00	40,600.00
Aug. Lowell Lab. Electrical Eng. Fund	10,000.00	32,000.00
Rebecca A. Goddard Legacy	1,000.00	1,000.00
Matilda Goddard Legacy		500.00
Barthold Schlesinger "	2,000.00	2,000.00
Edward Austin Fund	365,034.09	366,549.09
Teachers' Fund	103,800.00	104,000.00
Letter Box Fund		10.50
Students' Deposits	200.00	450.00
Roentgen-Ray Experiment Fund		1,000.00
Sewage Experiment Fund		5,000.00
Walker Memorial Fund		26,558.97
Samuel Cabot Gift Brookine Land Account		20,000
M. I. T. Stock Account	845,856.48	841,620.64
	$3,456,099.46	$3,552,623.64
Increase,		
Consisting of:		
Bequests for Special Purposes, etc. (See page 4)	46,951.05	
Gifts and Bequests for General Purposes. (See page 4)	21,000.00	
Students' Deposits	250.00	
Roentgen-Ray Experiment Fund	1,000.00	
Sewage Experiment Fund	5,000.00	
Net Gain on Stocks sold	1,656 30	
Walker Memorial Fund, net amount	26.558.97	102,416.32
Less Expenses more than Income		5,892.14
		$96,524.18

INCOME FROM GENERAL INVESTMENTS, AND APPLICATION THEREOF.

Applied to Salaries	4,324.00	From Dividends, Bank Stocks	980.15
" " Scholarships	10,550.00	" State Tax returned on Bank Stocks	242.94
" " " James Savage Fund	400.00	" Bonds	64,906.45
" " Charlotte B. Richardson Fund	1,495.15	" Dividends, Railroad Stocks	1,855.00
" " Teachers' Fund	4,000.00	" " Manufacturing Stocks	1,017.30
" " Edward Austin Fund	14,400.00	" Real Estate Stocks	2,915.00
" " Rotch Prize Funds	400.00		
" " Rotch Architectural Fund	1,000.00		
" " Library	480.00		
" " General Purposes	27,976.52		
" " Samuel Dorr Annuity	1,000.00		
" " Increase of Funds	1,268.92		
" " Advances to Bond Premiums	4,622.25		
	$71,916.84		$71,916.84

INCOME FROM WILLIAM BARTON ROGERS MEMORIAL FUND, AND APPLICATION THEREOF.

Paid Massachusetts Institute of Technology	10,838.00	Received Income from Railroad Bonds	11,663.00
Credited to Advances Bond Premiums	825.00		
	$11,663.00		$11,66.300

DETAILS OF SOME ITEMS IN TREASURER'S CASH ACCOUNT.

Rents.

Huntington Hall, for Lowell Lectures	1,750.00	
Land and Building, Clarendon St., on account	2,750.00	
Use of Rooms and Gymnasium	1,044.12	
Cambridge Real Estate	438.68	$5,982.80

Department Supplies.

Chemistry	11,162.89	
Physics	6,903.07	
Mining	4,787.12	
Mechanical Engineering	2,730.17	
Civil Engineering	2,441.35	
Workshops	2,143.70	
Architecture	1,893.52	
Periodicals	1,770.26	
Applied Mechanics	1,399.48	
Geology	1,332.68	
Biology	1,020.87	
English	982.97	
Naval Architecture	750.87	
Mathematics	201.09	
Military	157.21	
Drawing	121.40	
Modern Languages	104.62	$39,903.27

Salaries.

Instruction	228,864.05	
Administration	32,796.04	
Labor	29,841.20	$291,501.29

General Expense.

Furniture		3,263.70	
Stationery and Office Supplies		2,642.04	
Postage		2,626.82	
Electrical Wiring, Lamps, etc.		1,330.89	
Sundries		1,226.90	
Express		1,115.50	
Janitor's Supplies		1,096.38	
Examinations		900.41	
Diplomas and Commissions		619.40	
Washing		599.35	
Telephone Service, Installing Stations, Rentals, Repairs, etc.		486.25	
Engine Room Supplies:			
Oil	259.32		
Waste	68.84		
Sundries	62.40	390.56	
Library		317.45	
Ice		232.30	
Examination Books		217.07	
Graduation Exercises		174.20	
Removing Ashes		138.20	
Glass		137.77	
U. S. Vaults		75.00	
Gymnasium		71.59	$17,661.78

Repairs.

Department Improvements:		
Chemistry	3,890.03	
Mechanical Engineering	437.68	
Architecture	368.53	
Workshops	267.70	
Physics	266.09	
Mining	262.16	
Naval Architecture	150.54	
Geology	53.85	
Biology	47.61	
Civil Engineering	23.64	
English	3.76	
Applied Mechanics	1.25	5,772.84
Rogers Building		2,300.30
Walker "		1,648.39
Sundries		1,451.63
Steam Fitting		746.25
Engineering Building		580.47
Pierce Building		530.06
Boiler and Power House		277.62
Motor for fan for heating Huntington Hall		237.50
Gymnasium		103.70
		$13,648.76

BOSTON, November 14, 1902.

Mr. E. L. Parker, an accountant employed by this committee, has examined the accounts of the Treasurer of the MASSACHUSETTS INSTITUTE OF TECHNOLOGY for the year ending September 30, 1902, and his report is hereto annexed.

We have verified the list of personal property held by the Institute.

CHARLES C. JACKSON,
JAMES P. TOLMAN,
} *Members of the Auditing Committee.*

BOSTON, November 14, 1902.

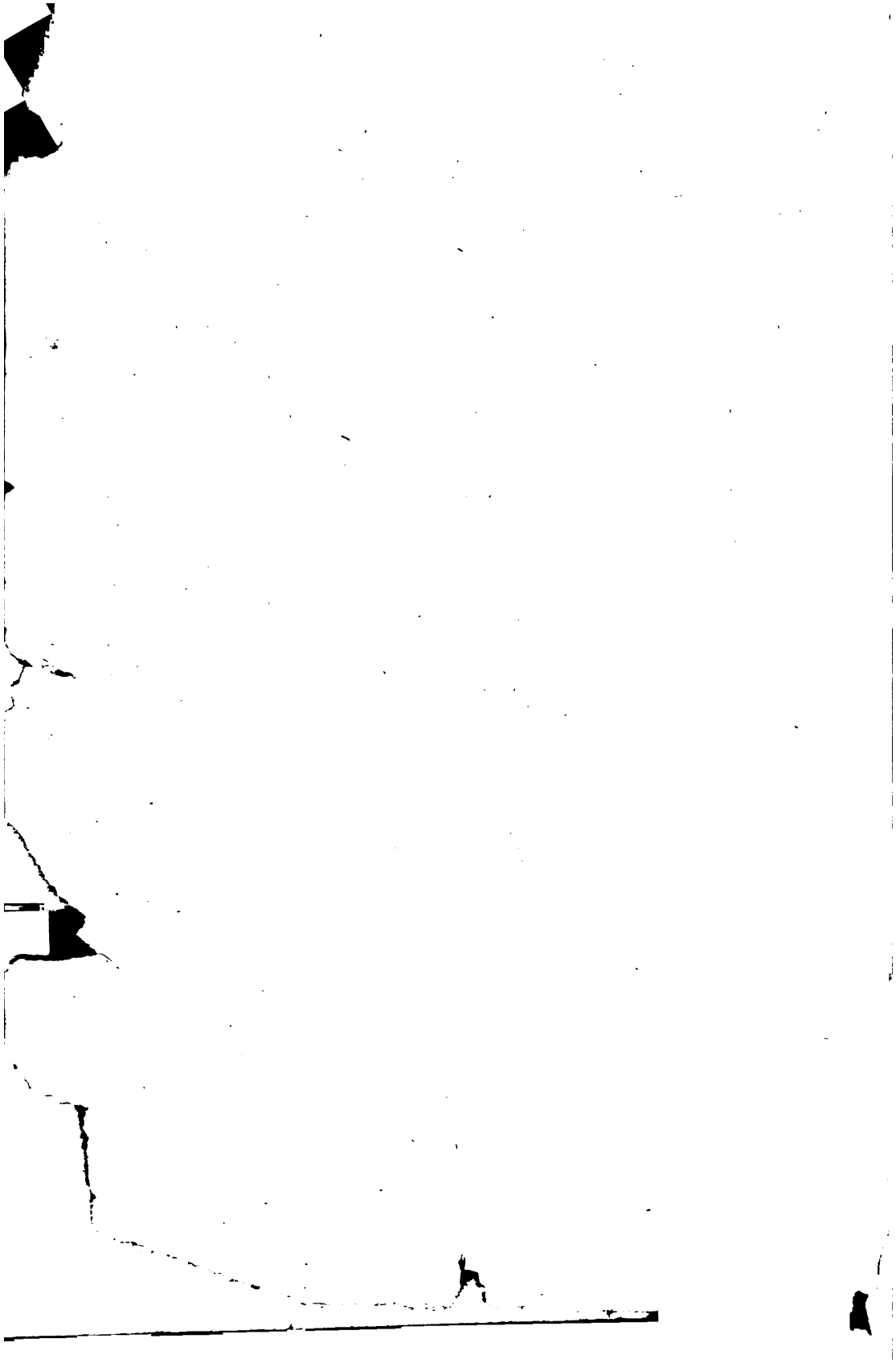
To the Auditing Committee of the
Massachusetts Institute of Technology:

GENTLEMEN,— I have audited the accounts of Mr. George Wigglesworth, Treasurer, for the year ending September 30, 1902.

They are correct, payments duly vouched, and the receipts from students' fees and all other income duly accounted for. The cash at office and in banks, according to the deposit books, is correct. The account of property held by the Institute and the funds and balances, as shown in the Treasurer's report of September 30, 1902, is in accordance with the books.

Respectfully submitted,

EDWARD L. PARKER,
Public Accountant.



MASSACHUSETTS INSTITUTE OF TECHNOLOGY

ANNUAL REPORT

OF THE

PRESIDENT AND TREASURER

DECEMBER 9, 1903

BOSTON
GEO. H. ELLIS CO., PRINTERS, 272 CONGRESS STREET
1904

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Members of the Corporation.

President.
HENRY S. PRITCHETT.

Secretary.[1]
FRANCIS H. WILLIAMS.

Treasurer.
GEORGE WIGGLESWORTH.

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W. MURRAY CRANE.

On the Part of the Commonwealth.

HIS EXCELLENCY, JOHN L. BATES, *Governor.*
HON. MARCUS P. KNOWLTON, *Chief Justice of the Supreme Court.*
_____, *Secretary of the Board of Education.*

[1] Correspondence should be addressed to Dr. H. W. Tyler, Secretary of the Faculty.

Committees of the Corporation.

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HENRY S. PRITCHETT.
GEORGE WIGGLESWORTH. } *Ex Officiis.*

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FRANCIS H. WILLIAMS. A. LAWRENCE LOWELL.
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PERCIVAL LOWELL.

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FRANCIS BLAKE. FRANCIS H. WILLIAMS.

Department of Naval Architecture.

CHARLES J. PAINE. WILLIAM H. LINCOLN.
HOWARD STOCKTON. CHARLES G. WELD.

PART I.

REPORT OF THE PRESIDENT.

To the Members of the Corporation of the Massachusetts Institute of Technology: —

The reports of the administrative officers, which I have the honor to present at this time, refer to the school-year beginning October 1, 1902, and ending September 29, 1903. For your convenience, and for greater clearness, the printed statement has been divided into five parts, as follows:

I. Report of the President;
II. Reports of the Dean and heads of Departments;
III. List of publications by members of the Instructing Staff during the year;
IV. Statistics and Report of the Registrar;
V. Report of the Treasurer.

GENERAL POLICY OF THE INSTITUTE.

This is the fourth annual report that I have had the pleasure to address to your body. During the three years that have elapsed since my first report, marked changes have come about in the Institute, and in the conduct of its work. In this interval, the student body has grown from about twelve hundred to approximately sixteen hundred; and, although the increase in tuition which took effect at the beginning of the present year (1903–04) has brought about a small decrease in the entering class, the large increase in preliminary examinations for next year indicates that there has been no real break in the growth of numbers.

During these three years I have endeavored, in co-operation with the Executive Committee and the Faculty, to proceed along three general lines of progress.

First of all, the effort has been made to improve the means of instruction; to discuss with the members of the Faculty,

not only questions of detail, but the fundamental questions of the education which the Institute is to offer. The effort has been made to keep the old spirit of work and of energy, but to adapt as fast as may be the machinery of instruction to present day needs. This effort has resulted practically in a reorganization of executive officers, and in additions and changes in the Instructing Staff and modifications of the Courses.

A second consistent policy of procedure to which the Executive Committee has committed itself, with your endorsement, has been the effort to improve the facilities of instruction and to make them the best possible. The creation of the Department of Electrical Engineering and the erection of its splendid new laboratories, the new building which houses the Department of Naval Architecture and the laboratory of chemical research, the establishment of a Graduate School of Engineering Research, all mark steps taken, not by reason of additional endowment, but without it, and in the faith that the Institute of Technology must occupy a foremost place in technical education.

A third effort, and one vitally connected with the wish to bring to the Institute new men and to improve its facilities, has been the effort to increase the income. Our income has grown in three years from $347,132 in 1900 to $436,808 in 1903, an increase of nearly ninety thousand dollars, equivalent to the interest on something like two and a quarter millions of dollars. This income has come almost entirely from the growth in student fees due to the increased number of students. Our expenses in the meantime have grown faster than our income, so that the deficit of the last year is larger than for some years past, and serves to emphasize the fact that in technical education increase of expense keeps pace with increase in numbers; and that such education, in the best sense, can be kept up permanently only by a generous grant from the State, or by a correspondingly large income from private endowment. Where the Institute of Technology is to find this endowment is one of the serious problems.

The reasons which impel men of large fortunes to give their money to institutions of learning are varied. Few such gifts have as yet come to the Institute; but I can scarcely believe that any man interested in the industrial progress of America could find a more fruitful field for his money than that which the Institute offers.

How far these general lines of policy may prove to be correct, the future will show. One result has been an increase in instructors and in facilities, and the treasurer in his report has called attention to the fact, which we must frankly face, that the expenditures of the last year have outrun the receipts by a considerable margin. Nevertheless, I cannot but believe that the policy which the Executive Committee has pursued, with your approval, is the true one. The Institute of Technology will fail of its real purpose if it fails to stand at the front of technical education. The Executive Committee feels that it has pursued the right policy in its effort to keep the institution there, and that the question of future income is one which must be dealt with, not by it alone, but by the Corporation as well.

LEGACIES AND GIFTS OF THE YEAR.

In the Treasurer's Report will be found in detail a statement of the benefactions which have come to the Institute during the past year.

The largest of these gifts are those from Mrs. William L. Putnam, Mrs. T. J. Bowlker and Miss Amy Lowell, of $10,000 each, for the purpose of erecting a permanent laboratory of electrical engineering, to bear the name of Mr. Augustus Lowell. This sum has also been further augmented during the year by a gift of $3,000 from Mr. Charles C. Jackson and of $3,000 from a friend. These sums, added to the gifts of Professor Percival Lowell, Professor A. Lawrence Lowell, Mr. George Gardner and Mrs. W. S. Fitz, make in the aggregate $68,000 given for this purpose.

A very interesting and very unusual gift is that of $5,000

for the Sewage Experiment Station. This is the second gift of this amount from a friend of the Institute and of science who desires that the pressing municipal sanitary problems of this and other American cities may be put in a fair way for solution. This generous donor prefers to remain anonymous.

Gifts aggregating $5,000 have been received for the support of the Research Laboratory of Physical Chemistry. These gifts are most welcome not only for the direction they have taken, but also for the enthusiasm and devotion of which they are only one evidence. Of this amount $3,000 is the gift of Professor Arthur A. Noyes, of the class of 1886, Director of the Laboratory, and $1,000 the gift of Assistant Professor Willis R. Whitney, of the class of 1890. The remaining $1,000 is from the fund founded by the late William E. Hale, of Chicago, for the promotion of scientific research. The establishment of this fund is in large measure the result of the scientific work of George E. Hale, Director of the Yerkes Observatory, of the Class of 1890. The officers of the Carnegie Institution have shown their appreciation of the value of the work of the research laboratory thus established by the appropriation of $2,000 for the work which Professor Noyes is prosecuting. No gifts, of whatever magnitude, will ever be more welcome to the Institute or more stimulating to its work than those which come from its own sons.

Four other gifts, amounting in all to $6,000, have been received as a nucleus of a fund for the establishment of dormitory life or such other student aid as may minister to the betterment of the social life of students. Of this amount Mrs. Edward M. Cary gave $3,000, the estate of Mrs. Mary Hemenway $1,000, Mrs. Henry Pickering $1,000, and a friend $1,000. This fund has been given to be used in the discretion of the President. I cannot but hope it may form the nucleus of a sum large enough to enable us in the near future to begin at least some practical measure for furnishing to students rooms at moderate prices, and under conditions which may be stimulating to manly, wholesome social life.

During the year $10,050 has been paid in on the subscriptions to the Walker Memorial Fund. The funds now in the hands of the Treasurer for that purpose amount to $83,466.70.

THE YEAR'S CHANGES.

The past year has been one of great activity in all directions. It has witnessed few changes in the membership of the Corporation and of the Faculty. The membership of the Corporation has been increased during the past year by the election of the Hon. W. Murray Crane, a citizen whom Massachusetts delights to honor. It has lost by death one member, the Hon. Frank A. Hill, secretary of the Board of Education, who, as such, was for many years a member *ex officio* of this body. Mr. Hill was chairman of the Visiting Committee on the Departments of Literature, History, and Political Economy, and took a genuine and hearty interest in the progress and welfare of the Institute.

The membership of the Faculty has changed by the resignation of Professor Linus Faunce, Professor Hough and Professor Locke, and by the accession to the Faculty of C. L. Adams as Assistant Professor of Drawing, H. W. Gardner as Assistant Professor of Architecture, F. P. McKibben as Assistant Professor of Civil Engineering, C. M. Spofford as Assistant Professor of Civil Engineering, and Samuel C. Prescott as Assistant Professor of Biology. During the present year Professors Bardwell, Bartlett, and Skinner have leave of absence.

THE GRANT OF LAND BY THE LEGISLATURE.

At the beginning of the last school year, the Executive Committee, in view of the crowded condition of the laboratories, felt compelled to recommend to the Corporation some step looking to the acquisition of more room. The first, and the most natural movement in this direction was evidently to

secure the title to the land on Boylston Street on which the Institute buildings now stand; for, with this land in our possession in fee simple, the pressure for space could be relieved, either by building over the whole tract, or, if it seemed wiser, by a sale of this land and removal to another site. In accordance, therefore, with your instructions, the Executive Committee presented this matter to the General Court in January by a petition praying for a title in fee simple.

The successful outcome of that effort is known to you. The General Court has conferred upon the Institute its title to the land in question. In the opposition which was called out in connection with this action there was made, from time to time, an intimation that the action of the authorities of the Institute in this matter was taken in disregard of the rights of others. While this effort to make out of the question a moral issue seems to me wholly unwarranted, it deserves to be put on record that the Executive Committee, in inaugurating this action, tried to approach the question in a fair and just spirit. The original Act under which the use of this land was conferred upon the Institute would seem plainly to indicate that the Commonwealth reserved to itself the right to use the space now left open for the benefit of the educational institutions established in that Act. Believing this to be the case, the Executive Committee has taken only the action which it felt compelled to take in justice to the interests of the Institute, and with the entire conviction that any rights of the abutters which were contravened under this action were such as rested upon purely legal considerations, and not moral ones.

I have to report to you that the legal questions involved seem in a fair way for settlement in the near future. I have been given to understand that a suit will be brought immediately by the abutters, to test the correctness of their interpretation of the law. A prompt and final decision of this matter is hoped for, and will be welcomed alike by the authorities of the Institute and by the owners of abutting property.

It is evident that, until this question has been decided, the

problem of greater facilities or of a possible new site must wait, since no practical action could be taken by this body looking to the furtherance of either of these solutions of the problem of our crowded condition until the legal questions thus raised have been quieted.

THE NEW BUILDINGS.

The Institute built, during the summer of 1902, the large one-story building known as the Lowell Building, which houses the Department of Electrical Engineering. During the summer of 1903 we have built still another building of two and one-half stories, which houses the Department of Naval Architecture, a research laboratory of physical chemistry, and the division of mineralogy, an important part of geology and mining engineering, for all of which the building is most admirably adapted.

While these buildings are in a sense temporary, they are adapted to use for a number of years to come, and have enormously relieved the pressure for space, as well as added facilities for instruction. In fact, with the beginning of this year the student body is better housed than it has ever been in the history of the Institute.

RESEARCH WORK IN THE INSTITUTE.

The most far-reaching and important changes which have marked the past year are the distinctive efforts now being made toward the prosecution of scientific research. The first is the organization of a School for Engineering Research, whose plan and scope have been fully presented in a special pamphlet printed for that purpose. The plan contemplates provision for research in applied science and in engineering directions, for a very small number of well-equipped men who are capable of executing pieces of research of real value and importance, and who shall have such freedom of work that

they may throw themselves with devotion into what they undertake. This is the first effort in any technical school in this country to offer research work distinctive from that of the college, and directed toward engineering subjects. While this school will offer an opportunity for earning the degree of Doctor of Engineering, it is intended that the conferring of the degree shall be a minor feature of the work, and that the few men who are admitted to this work shall be men who are aiming at research and not degrees. For the present year the only candidate who has been admitted is Professor Harold B. Smith, head of the Department of Electrical Engineering in the Worcester Polytechnic Institute.

A second and extremely promising effort at research is the Research Laboratory of Physical Chemistry, established under the direction of Professor Noyes, and in large part made possible by the generosity of himself and of his colleague, Professor Willis R. Whitney. It may not be generally known that in and about Boston are grouped a number of well-known men in physical chemistry; and the inauguration of this department, made possible originally by the gifts of its own professors, has been still further helped by grants from the Carnegie Institution and from the William E. Hale Fund.

The third research effort is that now going on in the work of the Sanitary Research Station, established last summer at the corner of Massachusetts Avenue and Albany street, which was made possible by the gift of a friend who prefers to remain anonymous. The work going on there deals not only with the problems of research, but also with the diffusion of knowledge by means of attractive pamphlets furnishing elementary sanitary instruction.

These three efforts mark a distinct step, not so much in the aim as in the progress of the Institute, and in the progress at the same time of technical education in this country. In taking a step under which the Institute plainly marks out its intention to offer facilities for research, as well as for undergraduate work, a definite effort is made to retain a position of leadership in technical education.

THE PLACE OF RESEARCH IN NATIONAL DEVELOPMENT.

In American institutions of learning one hears, of late years, much talk concerning research and the need for its existence; and in response to this general sentiment there has developed a series of graduate schools in all our principal universities. It is not over-stating the matter to say that in most respects these graduate schools, which now contain between six and seven thousand students, do not indicate any such increase in research work and in the growth of the research spirit as their numbers might imply. I am not sure that there has resulted even any definite idea as to what research is; and I am inclined to believe that the fundamental question itself, what constitutes research and what is the spirit which must exist in an individual and in an institution in order that research may flourish, is one to which American institutions need to devote themselves. Without going into a discussion of what research is, it is worth while to point out some of the difficulties which lie in the way of the development of research in our institutions, and which make it even yet a question of doubt whether our universities will ever become as efficient centers of research as those of some other countries.

The fundamental distinction which one finds in comparing our institutions with those of Europe is to be found in the difference between our elementary instruction and that given in our higher schools, universities, and technical schools. The education of the European boy in the school which leads up to the university or to the technical school is simpler and more thorough, so that, when he comes into the technical school or the university, he is a better grounded man in the fundamentals of education, and he enters into an institution where, in virtue of this fact, the entire method and spirit are changed. He no longer finds himself face to face with required daily recitations; he is practically freed from the burden of examinations, and he enters into a relation with his teachers which only men can have with each other.

No one who has not been a teacher can realize how enormous is the burden thus lifted from the shoulders of the Faculty and student alike. In the Institute of Technology practically one-eighth of the whole school year is given up to formal examinations. Under our system of instruction the Faculty is trying to carry through the courses a considerable proportion of men who are either incompetent or who do not care for the work. American institutions are almost the only ones in any country which undertake to force into the mind of an adult man a course of instruction which he does not care to have. The great activity in research in European institutions is due, first of all, to the spirit now alive there, which makes research a test of a man's success and of his efficiency; but it is due, to no small degree, to the fact that European teachers are relieved of this enormous burden which American teachers have upon their shoulders.

Looking at the German institutions, one feels that as research institutions they have great advantages over ours in these three respects. First, because research itself is a part of the ideal of the professor's life, and the spirit of research a part, and the most vital part, of the educational spirit. Secondly, their freedom from the burden of instruction which our teachers bear, and the opportunity thus afforded to give free play to the research effort. Finally, the fixity of place and the guarantee of a retiring salary, which removes the ever-present problem of support in old age.

How important is the development of the research spirit as a part of national progress we are only just beginning to realize. We may confidently say that it will count more and more in the future in this national progress, and the problem of developing it wisely and of turning it to the solution, not alone of theoretical questions, but of practical questions of national life, is becoming each decade a more real question for civilized nations. In America we have still the intellectual habits of a pioneer people. The American is energetic, resourceful, and superficial. He can make a little knowledge go farther than the citizen of any other country. Resourceful-

ness and nervous energy were great factors in the pioneer days, and they are great factors still; but they become relatively less effective as civilization advances. They will not last in competition with careful training and thorough knowledge. Our pioneer period has gone by, and one of the problems before the nation is the development of a patient, devoted, intelligent spirit of research. In order to develop this spirit an environment favorable to it must be created in our institutions of learning.

THE NEED OF A PENSION SYSTEM.

In this connection I venture to call your attention to the need in American institutions, and in our own institution, of a retiring system for professors and instructors. Mr. Augustus Lowell, for so many years a leading member of this board, and one of the most far-sighted men who have served this institution, gave $50,000 during his life-time as a Teachers' Fund, the interest of which should serve as the beginning of a fund for the payment of pensions to those who have worn themselves out in the service of the Institute. Later on, when he came to make a final gift to the Institute, he could think of no wiser use than to add another $50,000 to this fund; and I wish to say that to my thinking he could have made no wiser disposition of such a sum. I wish to urge upon your body the need of increasing this fund to a sum which will enable the Institute to guarantee to men of certain length of service a life pension.

Any man who knows American colleges and universities is familiar with the common experience of many of the abler young men who come up through our institutions, spend a year or two abroad, equip themselves well for the work of research, and settle down into the position of an instructor or assistant-professor in some institution, full of enthusiasm and ready to consecrate their lives to research work. Scientific men are human like other men. After a few years the investigator marries, the problem of family support becomes urgent, col-

lege pay is small, and, while it may pay current expenses, it offers no opportunity to lay up for the future. The candidate for research looks about for means of turning the grindstone; and a man who has started with flying colors and a buoyant heart for a fine career in research ends by becoming a fair teacher and a patient drudge. This is the history of most men who start in American institutions to become investigators. Tenure of office in all our American institutions, except in our greatest and strongest ones, is more or less uncertain. College presidents and college trustees, like business firms, are becoming more and more averse to accepting a new man who has passed his fiftieth year. I have known, in the past five years, men of excellent standing in science, who found it almost impossible, when turned out of one place, to secure work elsewhere. The in-breeding in our colleges, by which graduates are coming more and more to look for the places of instructors and professors, increases this tendency. Any plan which will enable the institution to offer to a professor or to an instructor a certainty of retired pay with the coming of age or of ill-health would go far to remove from his path as an investigator an obstacle which turns aside most Americans who enter upon research.

LOWELL INSTITUTE SCHOOL FOR INDUSTRIAL FOREMEN.

The ideal educational system for a progressive country would be one in which, instead of trying to run all men through the same mould, the schools should be so diversified as to meet the needs and the ideals and the aspirations of all classes of citizens. We have, in the United States, made but little progress toward this ideal. It is very difficult for our educators to outgrow the theory that there are certain educational specifics which, if taken in sufficient quantities, are suited to all sorts and conditions of men.

One of the neglected fields of education is that which has to do with men who stand between the unskilled worker and the

engineer. Most citizens of the United States necessarily leave the public school by the time they are fourteen. Once harnessed to the problem of earning a living, they find their opportunities for improvement in school necessarily limited to those which may be had in afternoons, in holidays, and in evenings; and such schools, if they are to serve those whose chief problem is that of earning a living, must be very closely adapted to serve the immediate needs which they have in view, although they may always carry with this purpose the wider one of upbuilding the character and the intellect.

While the Institute has felt it to be its chief duty to extend its work upward, so as to provide for the work of research, it has been glad, as well, within the last few months, to ally itself with the effort to reach down to serve the needs of men who wish to improve themselves for the occupation in which they earn a living. This effort has been consummated by cooperation with Professor A. Lawrence Lowell, the trustee of the Lowell Institute, who has established an evening school for foremen, which is conducted by Institute teachers in Institute rooms and laboratories. In this school stationary engineers, motormen, mechanicians, electrical workers, and other who are ambitious to improve their theoretical knowledge of practical matters, and thereby to fit themselves for better places, are given elementary instruction in those fundamental subjects which directly serve their needs.

This school is under the direction of Professor C. F. Park. For the present year about 160 men have entered its classes. These were all men engaged in practical occupations, such as draftsmen, electrical helpers, machinists, pattern makers, and the like. About one half found themselves, after a month of study, unable to continue, and the school now consists of about 80 men who are engaged most earnestly in its work.

THE SUMMER SCHOOL.

Until the season just passed the summer school of the Institute had been conducted by the independent efforts of members

of the Instructing Staff, with the co-operation of the executive officers and of the Executive Committee. In 1902 the work was assumed as a regular part of the work of the Institute, students being registered as for the regular work. The result has been in every way satisfactory, and has served to put the summer school upon a far better basis financially and in its relation to students.

Two hundred and forty-five students attended the regular summer courses, two hundred and sixteen of whom were from the Institute. By far the larger part of these latter were taking these courses either to make up deficiencies or to anticipate work in the regular term. How far the Institute should go in serving this end is not entirely clear.

A more interesting feature of the work is the presence of men, in increasing numbers, from other colleges, as well as the evidence of the fact that a very good majority of the students attending have done excellent work. Midsummer has not been considered a favorable time for study, but whatever disadvantages the weather may have imposed seem to have been more than counterbalanced by the fact that the student is generally taking but one subject, and can therefore throw himself heartily into the work. This fact is not without significance in comparison with the regular term-work of the Institute.

In addition to the Summer Courses at the Institute, three summer schools were conducted, which offered work supplementary to regular Institute instruction. These were the School in Geodetic and Hydraulic Surveying, at Machias, Maine, the School in Metallurgy, which inspected and studied various metallurgical plants, and a Summer School in Architecture which studied in France and Italy.

ADMINISTRATION.

The internatal administration of the Institute has been largely modified in the past two years by an increase in the number of general executive officers, and a differentiation of

their duties. This reorganization has included changes in the duties of the Secretary and of the Bursar, the appointment of the Dean, the Registrar, the Recorder and the Medical Adviser. The result has been a far more satisfactory administrative system, with regard both to the work itself and to its relations to the student needs. In the administration of an institution of learning it is never to be forgotten that the institution exists for the education of men, and that it is administered successfully when it becomes a live center of intellectual and moral influence. The machinery of administration must be arranged with reference to promoting this end.

REPORTS OF DEPARTMENTS.

I have alluded at this time more briefly to the needs and progress of the separate departments for the reason that the second part of this publication contains the report of the Dean and of those in charge of the departments, and of important divisions of the work of the Institute not formally designated as departments. For these statements of the departmental problems, made in the language and over the signatures of those most qualified to speak, I ask the careful consideration of the members of the Corporation. In the reports of the Dean and of the Medical Adviser will be found statements concerning problems of the student life which, while less easily defined than those of technical instruction, are nevertheless most far-reaching and important. These statements, together with the statistical exhibit and the Treasurer's Report which follow, serve to tell a story of progress and of work which I trust may commend to citizens of Massachusetts the work for which the Institute stands, and serve to bring to it in generous measure the financial assistance it so urgently needs.

HENRY S. PRITCHETT

DECEMBER 12, 1903.

PART II.

REPORTS OF DEPARTMENTS.

REPORT OF THE DEAN.

In accordance with the recently revised rules of the Faculty, the Dean is to be the general consulting officer for all students, and he is to co-operate with the President in all matters relating to discipline and the general welfare of the student body; he is to be chairman of the Committee of Advisers, and he is to have a general oversight of the first-year instruction.

A year and a half of experience indicates plainly the desirability of having a general consulting officer. The chief work of the office has been in connection with students who have voluntarily sought advice in connection with Institute work. The number of students sent to the Dean by Faculty vote or by the Registrar averages about 30 a month; the number who come voluntarily for consultation is much larger.

The number of advisers for new students this year is 60; the average number of students assigned to any one adviser is 7. The Committee of Advisers met new students in the library of the Rogers Building, September 28 and 29, 1903. This was done in order to facilitate the work of registration and to enable graduate students to consult with the heads of departments. There was a more definite organization this year, and the work of registration was completed more expeditiously than usual.

The Dean and the Committee of Advisers gave an informal reception on Friday, October 23, to new graduate students. In this list were also included students, not graduates, who had entered the Institute from other colleges. The reception was held at the Technology Club, and there were over 150 persons in attendance.

A card catalogue of all the students at the Institute is kept in the Dean's office. It is intended that these cards should show particularly a student's interest in the various social, literary, and professional societies, his connection with class

organizations, and his record in athletics. All reports of illness are entered on these cards, which also serve as an index to correspondence and personal memoranda.

A circular letter is sent, soon after the beginning of the term, to preparatory schools, inquiring about students who have been admitted. These replies and the card catalogue are found useful in considering the marks of first-year students at the intermediate examinations of the first term.

A room registry of about 220 rooms suitable for students has been kept in the office, and has been freely used by the new students.

Last spring an attempt was made to organize something of an employment bureau for undergraduates, and about 50 students obtained positions for the summer through this office.

Reports with reference to the Department of Drawing, to the Gymnasium, and to the Institute Exhibit at the St. Louis Exposition, are appended.

1. DRAWING.

Professor Faunce's connection with the Department of Drawing terminated in May, 1903, and the department was placed under the general direction of the Dean. Mr. C. L. Adams was promoted to the grade of Assistant Professor, and was asked to take direct charge of the instruction. During the summer a new programme of instruction was arranged by the Dean and Professor Adams. Two new instructors, Mr. E. S. Foljambe and Mr. J. R. Putnam, were engaged. Both of these men are graduates of the Institute in the class of 1901, and have had practical experience as draftsmen.

Professor Adams was prepared at the beginning of the term to inaugurate a new system of instruction, with new sets of printed notes. The elementary principles of Descriptive Geometry are studied at the beginning of the course. Instruction in the use of drawing instruments and practice in mechanical drawing is taken up incidentally in connection with the solving of problems. The class is divided into three sections, assigned to two-hour periods of work twice a week.

The first hour of the period is used for a lecture by Professor Adams. Students take notes, copying diagrams from the blackboard. The sketches made in the first hour are used in the second hour to furnish data for the mechanical drawing. This method was necessitated by the changes in this year's programme, and it has proved to be a more interesting method of instruction than the use of the text-book.

The second-year descriptive geometry is being taught by Messrs. Kenison and Bradley, and is a continuation of the instruction of last year. The students seem to be interested in their work, the machinery of instruction is running smoothly, and the new instructors have proved most efficient.

2. GYMNASIUM.

Dr. Skarstrom resigned his position of instructor in the Gymnasium in May, 1903. Mr. Winfield C. Towne, A.B., was appointed to take his place. Mr. Towne is a graduate of Bowdoin College. He entered Bowdoin in the fall of 1899, and, along with his regular college course, made a study of gymnastics; he made his various class football and track teams, and also the 'varsity football and the Worcester track teams. He was a member of the dumb-bell, broad-sword and fencing squads, being leader of the latter. During his Sophomore year he was made an assistant in the Sargent Gymnasium. During his last two years he was assistant to Dr. F. M. Whittier, A.M., (Director of the Sargent Gymnasium, Lecturer on Hygiene, and Professor of Bacteriology and Pathological Histology in the Bowdoin Medical School). During this time he was assistant instructor in the gymnasium, having entire charge of the Freshman classes.

Mr. Towne has devoted the first month of the school year to making physical examinations and measurements of students who present themselves for Gymnasium instruction. The regular class-work began, as formerly, November 9. The students have shown much interest in their Gymnasium work. Mr. Towne will carry out a programme which is, in general, the same as that of most of our American colleges.

3. Committee on Massachusetts Institute of Technology Exhibit at Louisiana Purchase Exposition, St. Louis, Missouri.

The Institute of Technology has been granted a space of one thousand square feet on one of the main aisles of the Educational Building. Detailed plans for the installation of the exhibit were made by Professor H. W. Gardner, and have been accepted as satisfactory by the Committee in St. Louis. Instructors have been appointed by the different departments of the Institute to collect material for the exhibition. Professor W. H. Lawrence and Professor L. Derr are now engaged in taking photographs of new pieces of apparatus, new laboratories, and new buildings. The exhibit will probably be ready by March 1, and must be installed and ready for inspection April 25, 1904.

Statistics of Illnesses for the School Year 1902–1903.

Senior Class.

Whole number of Senior Class, specials and regulars, 290.

Number of fourth-year students who were ill during the year 1902–03, 15.

Of this number, nine were graduated and received the degree from the Institute.

Of those who were ill, two were sent to the Massachusetts General Hospital, one with typhoid fever, and one for a second operation for appendicitis. The other 13 cases were of rather trivial character.

Fourth-year student who died, May 1, 1903, Alfred W. Bruton, Course VI., '03, drowned by canoeing accident.

Junior Class.

Whole number of Junior Class, specials and regulars, 360.

Number of third-year students who were ill during the year 1902–03, 38.

Of those who were ill, seven cases were treated at hospitals; two each at Massachusetts General Hospital, City Hospital, Boothby Hospital, and one case at unknown hospital.

Classified by diseases, there were the following cases: 1 appendicitis, 5 typhoid fever, 1 diphtheria, 8 grippe, 1 scarlet fever, 3 tonsillitis, 3 bronchitis, 1 mumps, 2 operation, 1 nervous condition, 2 cold on lungs, 1 water on knee, 1 accident to eye, 1 injury by accident, and 7 cases of illness unknown.

Of the cases treated at hospitals, there were two deaths: Eliot Granger, appendicitis, Massachusetts General Hospital; R. A. Lauffer, typhoid fever, Boothby Hospital, Nov. 5, 1903.

Sophomore Class.

Whole number of Sophomore Class, specials and regulars, 462.

Number of second-year students who were ill during the year 1902–03, 42.

Of those who were ill, three were sent to the Massachusetts General Hospital, two ill with rheumatism, one with typhoid fever.

Classified by diseases, there were the following cases: 4 tonsillitis, 1 influenza, 2 bronchitis, 1 appendicitis, 1 measles, 4 grippe, 2 fever, 1 diphtheria, 1 cold, 1 burned, 1 German measles, 2 rheumatism, 1 trouble with eyes, 1 malarial fever, 1 operation on hand, 3 typhoid fever, and 15 cases of illness unknown.

There were two deaths among the members of this class: F. W. McConnell, Course II., '05, died Jan. 7, 1903, typhoid fever; H. R. Sweetser, Course V., '05, drowned June 15, 1903, off Misery Island.

Freshman Class.

Whole number of Freshman Class, specials and regulars, 479.

Number of first-year students who were ill during the year 1902–03, 54.

Of those who were ill, one case was treated at the Homœopathic Hospital.

Classified by diseases, there are the following cases: 5 tonsillitis, 2 mumps, 3 grippe, 1 cold on lungs, 2 appendicitis, 1 severe intestinal trouble, 1 quinsy, 1 rheumatism, 1 abscess on foot, 2 measles, 5 typhoid fever, 1 pleurisy, 2 pneumonia, 1 operation, 1 abscess in ear, 2 trouble with eyes, 1 jaundice, 1 sprained leg, and 21 cases of illness unknown.

There were two deaths among the members of this class: Francis A. Falvey, '06, died January 14, 1903, appendicitis; Thomas B. Watson, '06, severe intestinal trouble.

TOTAL.

	No. in Class.	*No. Ill.*	*No. treated in Hospitals.*	*No. of Deaths.*
Fellows and Graduates of M. I. T.	17			
Fourth Year, 1903	290	15	2	1
Third Year, 1904	360	38	7	2
Second Year, 1905	462	42	3	2
First Year, 1906	479	54	1	2
	1,608	149	13	7*

REQUIRED TO WITHDRAW.

	Courses.									
	I.	II.	III.	IV.	V.	VI.	X.	XI.	XIII.	Total.
January, 1903:										
Third Year	2	3	2	–	–	1	1	1	–	10
Second Year	–	6	–	1	–	–	–	–	–	7
First Year	1	–	–	–	–	–	–	–	–	1
										18
June, 1903:										
Third Year	4	1	–	–	–	1	1	–	–	7
Second Year	2	5	–	–	2	4	–	–	2	15
First Year	21	–	–	–	–	–	–	–	–	21
										43
Total for the Year	30	15	2	1	2	6	2	1	2	61

ALFRED E. BURTON.

* Of this number, two were the results of accidents.

REPORT OF THE MEDICAL ADVISER.

Office hours have been held in the Pierce Building once a week until the middle of November and since then twice a week. The following table gives the number of office visits made and the number of students seen: —

Total number of office visits made	254
Total number of different students seen	156
Greatest number of students seen per hour	7
Least number of students seen per hour	2
Average number of students seen per hour	5
Number of students making more than one visit	33
Largest number of visits for one student	6

The time set apart for medical visits has been fully utilized. Almost all of the students seen were men; not more than three or four women came for advice. Four-fifths of the students found it necessary to come only once,— usually for the treatment of some acute and promptly curable condition. Many of those making several visits in succession were surgical cases which required dressings. The Institute is not a place for invalids, and it was natural to find that only an exceptional man needed frequent medical advice.

The average number of students seen per hour was five. This is as large a number of men as can be satisfactorily seen in one hour, as this allows only an average of ten or twelve minutes per student. The number of students seen would have averaged less than five per hour had it not been for occasional students who simply came to ask for the name of a specialist whom they might consult. Frequently in surgical cases, and where minor operations were performed, much more time was required per man. When the office hour was held only once a week, there were always several men left over at the end of the hour who could not be seen within the appointed time. Since the office hours have been held twice a week, there are only occasional days when students are left over.

The severity of the illnesses varied much. Some diseases,

such as pulmonary tuberculosis or gonorrheal ophthalmia, necessitated leaving the Institute permanently. Several men suffering with typhoid fever walked into the office for advice and were promptly put to bed in a hospital. A few wounds or crushed hands came from the shops. Most of the illnesses, however, were acute and promptly curable.

A considerable number of healthy men, after reading newspaper advertisements or quack circulars, were very apprehensive about their health, and were greatly pleased to find that there was no cause for alarm. I was glad to find that men were willing to consult me freely on all matters relating to their physical condition.

A considerable number of students were recommended for admission to the hospitals for the treatment of such diseases as typhoid, pleurisy, measles, etc. The Massachusetts General Hospital was used for most cases in preference to the City Hospital because the Institute has free beds at the former hospital and because the cost of treatment there for out-of-town students appeared to be less.

I have tried so far as possible to keep in touch personally with all students who were being treated in the hospitals.

In addition to the work at the Institute office, I have seen about twenty-five sick men at my private office, and have examined twenty-five men for track teams. I have been called to attend a small number of men at their houses. The small number of these last cases is not surprising when we consider the scattered residence of the students and the natural inclination to call a doctor who is near by.

On account of the prevalence of small-pox in Boston, notices were posted urging all students who had not been successfully vaccinated within five years to be vaccinated again, and several office hours were set apart for this purpose. Only a small number of students availed themselves of this opportunity, possibly because most of them had been vaccinated during the epidemic of the previous year. There were no cases of small-pox among the students.

A small typhoid epidemic appeared among the Institute

students and others taking their meals at a local restaurant. Fourteen Institute men were infected with typhoid and there was one death. As soon as the outbreak was discovered, all of the students taking their meals at this restaurant were privately warned of the condition of things and no more typhoid cases developed. The Boston Board of Health investigated the matter and concluded that the epidemic originated from two servants in the restaurant who were ill with typhoid.

The following table gives a rough classification of the cases treated: —

Surgical	36
Stomach and Bowels	16
Genito-urinary	15
Nose and Throat	17
Eyes	17
Skin	22
Specific infectious diseases	9
Heart	4
Lungs	9
Ear	4
Miscellaneous	26

An informal lecture on "The Hygiene of Student Life" was given by Professor Sedgwick, and a talk on personal hygiene by the Medical Adviser. I think in future this series of lectures should be extended somewhat. The Medical Adviser might cover the following topics briefly in two or three lectures, namely:

Bathing
Clothing
Exercise
Sleep
Food
Care of the eyes
Use of tobacco and alcohol
Minor ailments, such as constipation, colds, headaches, etc.
Emergencies.

In addition to the lectures and actual work of caring for sick students, many letters of parents have been answered, advice given to instructors about necessary isolation in case of infectious diseases, and at present an inquiry is being made about the health at graduation of the last senior class, to determine the effect of the Institute course upon their general health and fitness for mental and physical work.

The cost of equipment of the Medical Adviser's office has been as follows: for permanent articles, such as instruments and glassware, forty-seven dollars; and for supplies, such as gauze, cotton, bandages, chemicals, etc., twelve dollars and twenty cents. All the permanent equipment and more than one-half of the stock of supplies is on hand at present. It is evident that the yearly cost of supplies will be very small.

FRANKLIN W. WHITE, M.D.

THE GRADUATE SCHOOL OF ENGINEERING RESEARCH.

For the purpose of encouraging and promoting advanced study and especially investigations of engineering problems of practical importance, announcement was made shortly before the summer vacation that the Institute stood ready to organize a special department of its graduate work to be known as the Graduate School of Engineering Research.

After careful consideration by the Faculty, a committee of that body, called the Council of the Graduate School of Engineering Research, was appointed; four fellowships carrying a stipend of $500 and free tuition were made available for candidates of the highest grade; and a circular was issued drawing attention to the opportunities afforded at the Institute for work of this character, and laying down the conditions of entrance and promotion. In order to emphasize still further the technical character of the undertaking, it was voted by the Faculty that the degree of Doctor of Engineering should be conferred upon candidates fulfilling certain prescribed conditions.

During the summer a considerable number of inquiries from young men desiring to enter the school was received, but nearly all were found to be inadequately prepared for admission to a graduate school of engineering research. Only one candidate has thus far appeared whose qualifications appeared to the Council to be adequate and satisfactory.

It does not seem likely that there will be for the present more than a very small number of candidates for admission to an advanced or research school of this kind, because only a very small fraction of the graduates even of our best technical schools are prepared to meet the exacting requirements properly laid down for work of this character, while the graduates of universities and colleges of the ordinary type are as a rule still less qualified. Another consideration which weighs heavily with prospective candidates is the financial problem, inasmuch as qualified candidates must have spent at least four years in expensive preparation, and, at the end of such a period of outlay, many find their financial resources exhausted. For this reason I consider it extremely important that every possible encouragement in the form of fellowships and graduate scholarships should be held out to prospective candidates.

The principal difficulty, however, with which an undertaking of this kind must contend is the attractiveness and real importance, from a scientific as well as a professional standpoint, of actual practice in engineering enterprises and undertakings. It is now, and must always remain, a fair question whether a young man who has completed a laborious and extended course of study in a technical school or university should not, for his own best development, and for the sake of the cause in which he is interested, connect himself at once after graduation with some large practical engineering enterprise, for the sake of gaining actual practice in the field; and this, as I conceive, will always be the principal drawback to the success of an undertaking of this character, judged by its number of students.

I am persuaded, nevertheless, that the existence of oppor-

tunities of the kind offered in our Graduate School of Engineering Research is of great consequence, not only to the Institute, as an engineering school of the highest rank, but also in its effect upon young engineers, and upon the engineering arts and industries themselves. It is only by aiming at the highest that we shall ever achieve the greatest success and if, as seems certain, the Institute is destined by its already leading position to attract more and more graduate students, and to become more and more a graduate school, there can be no question that everything should be done which can be done, to enlarge and improve our facilities, and to encourage young men to undertake advanced studies and investigations in engineering and industrial lines, as well as in the sciences of which engineering is simply the intelligent application.

W. T. SEDGWICK,
Secretary of the Council.

COURSES I. AND XI.—CIVIL ENGINEERING AND SANITARY ENGINEERING.

The number of students in this department, and the number of students in other departments taking work in this department have increased to such an extent that a considerable addition to the teaching force has been found necessary. Mr. Spofford and Mr. McKibbin have been promoted to be Assistant Professors, and three new assistants have been added. Further additions to the staff are even now necessary, if complete instruction is to be offered in the School of Engineering Research. Moreover, the problem of arranging the field work in civil engineering, which, to be effective, must be done continuously and at a distance from the school, is a very serious and difficult one. Some years ago the solution adopted was to devote each afternoon to this work. This plan, however, involved too much loss of time going to and from the work, and the modification now in force was made of devoting three entire days each week to field work, two for

the second year in surveying and one for the third year in advanced surveying and railroad location. This enables each class to have one day each week. The only alternative to the present arrangement seems to be to concentrate the field work in the summer vacation, but this has so many objections, financial and practical, that it has never been attempted or, indeed, seriously considered. With the present arrangement, however, no considerable increase in the number of students can be allowed, without diminishing the efficiency of the instruction, nor will an increase in the number of inexperienced and young assistants solve the problem. It is a grave mistake to intrust the earlier classes entirely or largely to inexperienced teachers, reserving the experienced teachers for the higher branches. For the best results, it would, perhaps, be better to reverse the arrangement, if that were the only alternative. The satisfactory arrangement of the work becomes increasingly difficult as the number of students increases, and can be accomplished only by adding to the staff not simply inexperienced assistants, but also instructors and assistant professors.

The space at the disposal of the department is becoming very cramped, in view of the increase in the number of students, and will imperatively require enlargement if the increase continues. The space occupied has not been increased since 1898, when the Henry L. Pierce building was built, although the number of students that can be classed as belonging to the department has increased some 30 per cent. within the same period, not to mention the even larger increase in students of other Courses who take work in surveying. Moreover, the engineering library is now so crowded that it is little more than a store-room for books. There are but two large tables available in it for students, and not more than thirty or forty students can by any possibility be accommodated there at one time. The time has arrived when the space available for the Civil Engineering Department and the library should be increased.

The equipment of the department is being gradually added

to as occasion requires. During the past year the gauging station on the Charles River at Newton Upper Falls, which had been injured by the floods, has been rebuilt in a more substantial manner and has been made use of by the State Board of Health for gauging purposes. A Doble regulating nozzle has been added to the equipment of the hydraulic laboratory. Further additions to the equipment are needed, and it would be desirable if larger appropriations could be authorized for this purpose.

The demand for graduates in civil engineering has continued almost unabated. A larger number than the entire class graduated last June, which numbered thirty-one, could have been placed in positions before the close of the term, while since that time many additional positions have been available. I cannot remember a year since my connection with the Institute began in which the demand for graduates of the Civil and Sanitary Engineering Courses has not exceeded the supply, even during the dull years from 1893 to 1897. With the excellent records which our graduates are making, it is probable that the demand will continue to exceed the supply. Mention may be made of the very gratifying result of the recent examination held for the position of assistant civil engineer in the Navy, at which nine candidates presented themselves. Of this number four were passed; of these four, the three highest were graduates of our Civil Engineering Department in the class of 1900.

Professor Allen was in July last elected President of the Society for the Promotion of Engineering Education for the ensuing year.

It may be of interest to state that, out of about two hundred students in the three upper classes in Civil and Sanitary Engineering, sixty-five worked at engineering occupations, while forty were employed in non-engineering occupations, during the summer just past, the total amount earned by these students being over $16,000.

Summer School in Civil Engineering.—The sixteenth session of the summer school of the Civil Engineering Depart-

ment was held during the past summer at East Machias, Maine. Twenty-four students were in attendance. Nine of these students were from the third-year class, and fifteen from the second-year class. The second-year students paid $25 tuition and by this work anticipated the field work of the third year.

The school was in charge of Professors Burton and Robbins, assisted by Professor Barton, Mr. Sweet, and Mr. Hosmer, together with Mr. Morse, Mr. Davis and Mr. Howard of the class of 1903.

A plane table survey, based on a base-line measurement and system of triangulation, was made of the village of East Machias, covering over a square mile of territory. The scale of the survey was 1 to 5,000, with a contour interval of 10 feet. Elevations were referred to mean sea level, determined by means of a tide-gauge set up near the mouth of the East Machias River. The plane table survey was connected with the general system of triangulation on the Atlantic Coast by occupying the United States Coast and Geodetic Stations at Howard Mountain and Indian Hill, and measuring angles to triangulation stations in East Machias. These lines of sight were long enough to require the use of heliotropes for signalling.

A profile was made of the East Machias River, and hydraulic measurements were taken by means of floats and meters, thus procuring data for an estimate of the water power.

Geological sections were surveyed with a transit and stadia.

Astronomical observations were made for the determination of latitude, meridian, and time. This school was the largest and most successful summer school which has been held by the Civil Engineering Department up to the present time.

GEORGE F. SWAIN.

COURSE II.—MECHANICAL ENGINEERING.

The number of students for whom instruction is provided by the Departments of Mechanical Engineering and Applied Mechanics has, within the last few years, undergone a very large increase; partly on account of the growth of the Institute itself; partly on account of the fact that instruction in some of the subjects taught in these departments has been added in two of the four-year Courses in which it was not formerly included, and that in another case additional instruction had to be given; partly because work had to be provided for graduate students of certain departments; and partly for other reasons.

The number of students to whom instruction is given in applied mechanics is four hundred and seventy-five; while the number who receive instruction in mechanical engineering subjects is six hundred and twenty-eight.

In the case of the Engineering Laboratories, which are called upon to provide instruction for about three-fourths of all those who graduate from the Institute, no important addition has been made to the apparatus for the last four years.

In consequence of these facts, it follows that, in order to keep up with the times, we are in great need of a very considerable amount of additional apparatus, not only to enable us to pursue investigations along new lines of very great importance from an engineering standpoint, but also to provide for our regular laboratory classes the amount of instruction required. This would involve the addition of apparatus of kinds that we do not possess, and the duplication of some that we have. Indeed, in certain portions of the work, we have already been obliged to decrease the amount of laboratory instruction given to each student. The above stated needs have been yearly explained in detail, in the recommendations made to the Budget Committee, and it is hoped that the Executive Committee may soon see its way clear to supply them. Moreover, if an amount of additional apparatus adequate to

the needs of the departments is provided, an increase of space will also be requisite.

In accordance with our usual custom, a considerable amount of investigation is always in progress, partly by means of the regular laboratory work, and partly by means of thesis work. As examples of investigations which have been carried on in whole or in part, during the last school year, and during the last summer, the following may be mentioned: —

1. Experimental investigations of the strength, and other resisting properties of full-sized re-enforced concrete beams, and of full-sized re-enforced concrete columns. This work formed the subject of two theses, and the results thus far obtained were published in the *Proceedings of the American Society of Civil Engineers* for 1903, Vol. 50, p. 483 *et seq.*

2. A forty-hour test of a 3700-horse-power unit of the Lincoln Wharf Power Station of the Boston Elevated Railroad was made as part of the regular laboratory work, the opportunity having been furnished through the kindness of the officials of the road. An opportunity for performing such laboratory work outside the Institute cannot always be obtained.

3. The following plant tests have been made as thesis work, viz.:

(*a*) A series of tests of the steam plant at the mills of the Amoskeag Manufacturing Co., at Manchester, N.H.

(*b*) A twenty-four hour test on the high duty pumping station at New Bedford.

(*c*) A twenty-four hour duty test on the Brookline high service pumping station.

(*d*) A test on the Westinghouse Parsons steam turbine at Hartford, Conn.

(*e*) A series of tests on a De Laval steam turbine.

4. Tests, partly as thesis work, and partly as regular laboratory work, on the quantity of air flowing through orifices of different sizes. Orifices have been calibrated thus far up to a diameter of two inches, and up to a pressure of three hundred and fifty pounds.

5. Experimental determinations of the pressure and temperature curve of sulphurous acid gas have been made as thesis work, this research having a special value as applying to the waste heat engine. These results were presented to the American Society of Mechanical Engineers at the meeting of December, 1903.

6. Two eighteen-hour and two eight-hour road tests of a heavy compound freight engine were made upon one of the most modern locomotives of the Boston and Maine Railroad.

7. An investigation of the effect of bends, and of different lengths of piping, upon the indicator card, were made by means of a high-speed passenger locomotive on the Boston and Maine Railroad.

8. An investigation has been begun, and is being continued as thesis work, upon the strength of a series of connecting rods, which have been furnished by the Baldwin Locomotive Works.

9. Some work has been done by means of a thesis upon the question how to avoid the presence of moisture and consequent freezing in the various parts of the air-brake equipment of freight trains.

In consequence of the large number of students, and the consequent increase in the amount of instruction required in almost all parts of the work of the departments, it became necessary to increase the instructing force by five additional assistants.

GAETANO LANZA.

COURSE III.— MINING ENGINEERING AND METALLURGY.

The changes to be noted in this department are chiefly rearrangement of and additions to the working appliances, to meet the needs of the increasing number of students. For example, in the ore-dressing laboratory : the round table has been remodeled — a trommel has been introduced, a new Wilfley table has been designed, and a Wilfley slimer, presented by

Mr. Wilfley of Denver, has been installed. In the metallurgical laboratory the furnaces have been completely equipped with tools. Some electrical furnaces for research work in heat are being erected in the heat laboratory. In the metallographical laboratory a second microscope has been added. The museum has been enriched by a complete set of products of the concentrating, smelting, and electrolytic plant of the Anaconda Copper Company, collected and presented by Mr. C. D. Demond, class of '93.

The library has at last completed its set of the leading Belgian periodical, the *Revue Universelle des Mines, de la Métallurgie*, etc., and has added a new bookcase to keep up with its growth.

In regard to next year's work, it will be impossible to do justice to the larger classes in assaying without some provision for additional room.

Metallographic work is now distributed over three separate parts of the Institute, while these different branches ought to be combined to form a single unit and thus encourage the undertaking of advanced research work. In the same manner our furnaces for advanced research work in heating ores, metals, and metallurgical products have to be placed in the heat laboratory, while they ought to be in a special place in our department where the research is being planned and worked out.

The mining department needs double its present floor space whenever a new building can be provided.

The summer school of metallurgy was held this year in western New York and Ohio. The metallurgy of copper, iron, and steel, and the manufacture of coke in by-product ovens were made the subjects of study at Syracuse and Buffalo, N.Y., and at Cleveland, Ohio. On the way to Syracuse a side trip was made to Mineville, near Lake Champlain, N.Y., and several days were spent there in studying the celebrated iron ore deposits and the recently installed magnetic concentration plants.

ROBERT H. RICHARDS.

COURSE IV.—ARCHITECTURE.

The department opened this year most favorably, both in the quality and in the increased number of students. The Graduate Course is filled, and it has been found necessary to add another instructor in design to the regular staff. It has been our good fortune to secure for this position Mr. Allen H. Cox, a former student of the Institute, and later of the Paris Beaux Arts. With Mr. Putnam, another of our men, he won in the recent competition for the new library building of the Boston Athenæum. Mr. Cox will continue to practice his profession, but will devote the afternoons to the Institute. The opportunity to obtain the services of one so able and enthusiastic, who brings with him a good knowledge of both theory and practice, is a rare one, and the department is to be congratulated on its accession. An assistant is also greatly needed to aid in the several courses in construction, perspective, stereotomy, etc. The preparation and correction of plates increases so much the labor of the instructor, that it leaves him too little time to give to the improvement or extension of his course. Another recitation room furnished with blackboard, and tables to which the students could take their drawing boards, would add greatly to the effectiveness of instruction, and would also relieve the class-room of a disturbing element, when occupied as it has to be very often by both those taking and not taking a specified course. It must besides be accepted that the department becomes more and more administrative, and in consequence assistance should be allowed to relieve its increasing routine work.

The increased number of students adds comparatively few to the general average of graduates. This is due largely to the fact that so many come to us who already hold a college degree, that the value of another is not considered of enough importance to warrant the necessary work along sometimes uncongenial lines to win it. In fact they come to us as to a graduate school, and specialize their work. With the special

student from the office, the case is different, as his time as a rule is too limited for him to hope for the degree, and he devotes himself to design or construction according to his taste. The results from both regular and special students might be better if the mathematical preparation for professional work were made less burdensome.

Through the continued generosity of Mr. Guy Lowell, the department was enabled, at the end of the last term, to offer attractive money prizes for sketches and more serious work, to be made during the summer vacation, with the result that an interesting exhibit has been held, and the prizes awarded. The end hoped for was not fully accomplished. As usual the busiest men responded the best.

This year the summer school was held in Europe with Professor Gardner in charge. The party of five landed at Naples and travelled slowly, studying and sketching, through Italy to Paris, and returned home by the way of Liverpool. The results are far better than when the class was much larger, with more divided interests.

How the Year Book shall be published in the future is a question that calls for careful consideration. At present this is done through the Architectural Club, an organization within the department, and much time and energy is devoted to making the work a success. It is the sincere hope of the department that the Year Book may be continued, without advertisements, but under the protection of the Institute and supported by its generosity.

FRANCIS W. CHANDLER.

COURSES V. AND X.—CHEMISTRY AND CHEMICAL ENGINEERING.

The removal of the laboratories of physical chemistry to the new building, Engineering C, has made it possible to restore to the laboratory of analytical chemistry on the fourth floor of the Walker Building the space partitioned off some years ago, and this change has provided sufficient desk room

in analytical chemistry for the present year and apparently for the immediate future. It has also released a much-needed private laboratory for the use of Professor Norris. The advantages to the department as a whole from this gain in space are, however, in some measure offset by the disadvantages which accrue from the present distribution of the various chemical laboratories and lecture rooms, which comprise parts of four buildings, three of which are at a considerable distance from the chemical library, as well as from the main base of supplies, and it is obvious that a recombination of these branches of the departmental work in one, or at most two, buildings will, when that shall become possible, add to our efficiency.

The need is still felt for more and adequate accommodations for certain members of the instructing force and for a suitable room for the storage and exhibition of the growing collections of raw materials and chemical products which have been presented to the Institute. While no effort is spared at present to give all possible effect to these valuable aids to instruction, much of the benefit which would accrue from a properly classified exhibit in a room set apart for the purpose, and accessible at all times to students for inspection, is necessarily sacrificed under present conditions.

The transfer to less restricted quarters of the laboratory devoted to instruction in the application of optical instruments to methods of chemical analysis is in the highest degree desirable, and would contribute much to the success of the work in this field, as it has been developed by Mr. G. W. Rolfe.

Since last year the instruction in theoretical chemistry has been greatly improved and extended by an increase in the number of lectures given upon the subject, and especially by the introduction of an illustrative laboratory course as an accompaniment to the lectures. This development has been made possible by the appointment of an instructor who devotes all his time to the subject and by the equipment of new laboratories for physico-chemical work. These are located in the newly erected building on the corner of Trinity Place and

Stanhope Street in immediate connection with the Research Laboratory of Physical Chemistry. One room with ample accommodation for seven students is devoted to the undergraduate work, being used during the first term for the regular laboratory work above referred to, which is taken in sections by all fourth-year chemical students, and during the second term for the thesis work of those students who elect physico-chemical investigations. Another laboratory is provided for graduate students, two of whom are this year taking advanced courses in physico-chemical study and research. Taking into consideration the provision made for instruction on the physical side of the subject in connection with the Department of Physics, it is believed that the facilities for work in physical chemistry now offered by the Institute are unsurpassed.

As a consequence of the increased entrance requirements in modern language, which diminished the complexity of the subdivisions of the entering class, it has become possible to divide this class into two large sections with reference to their previous experience in chemistry. This, in turn, has made it possible to offer a somewhat more advanced course of lectures and laboratory work in inorganic chemistry to those students who have already spent some time in the study of this science in the secondary schools, in which the knowledge of the subject already acquired is utilized. The opportunity thus afforded to adapt the instruction to the needs of both the beginner and the student of some experience is proving to be of great advantage. It is proposed to strengthen the course further by the addition of one recitation hour each week in the second term.

The instruction in the Laboratory of Industrial Chemistry has been much strengthened during the past year under the direction of Professor Walker. The primary purpose of the course is now to point out, and emphasize by laboratory practice, the particular classes of problems which are involved in the successful and economical conduct of chemical operations upon a technical scale. While the problems which it is pos-

sible to assign necessarily lack some of the essential features of those met with in a large chemical works, they still properly serve as types of such problems, and involve the same power of observation and reasoning as the latter. By means of a series of conferences the individual student is enabled, before the work is undertaken, to present for approval his reasons for the selection of a particular procedure or his choice of apparatus, due account being taken of the cost of materials, fuel, and labor involved; and on the completion of his work his recorded results, with his conclusions as to his success or failure, are submitted for criticism.

Similar conferences are held with groups of students, or with the entire class, upon problems to the solution of which each has contributed some experimental data. A report, accompanied by drawings or sketches of apparatus, and containing critical comments upon some special process, is required from each student, and the interest evinced and the care taken in connection with these reports is gratifying evidence of the practical character and efficiency of the instruction.

It is expected that a Summer Course of Industrial Chemistry will be held next June, and arrangements are already being completed for visits to a variety of chemical manufacturing plants.

The Course in Chemical Engineering has been so modified as to permit the completion of the work in carpentry and wood turning in the second year, instead of in the fourth year, as formerly. In the senior year a course of lectures upon the chemical resistance of materials will be given by Professor Walker, which, for the present year, will be given in connection with the instruction in applied chemistry. The course of instruction in the latter subject is also undergoing extensive revision.

Additional time will soon be released for the lecture course in organic chemistry of the third year, by the transfer of the course in industrial electricity to the fourth year, and, for the current year, pending a permanent alteration of the course, the time formerly given to instruction in technical machin-

ery will be devoted in part to laboratory practice with dynamo machinery, and in part to thesis work. The topics formerly included in the course on technical machinery are now adequately covered in other courses.

H. P. TALBOT.

RESEARCH LABORATORY OF PHYSICAL CHEMISTRY.

Shortly before the close of the last school year the Institute received offers of gifts amounting to $5,000 from three different sources — $1,000 from the William E. Hale Research Fund, and the remainder from two members of the Institute Faculty, to be used in maintaining through the following year a Research Laboratory of Physical Chemistry, in case the Institute was able to equip such a laboratory and assist in its maintenance. In order to take advantage of this opportunity for developing advanced study and research work, the Executive Committee voted to establish the proposed Research Laboratory and to make provision for it in the new building erected on the corner of Trinity Place and Stanhope Street. The second story of that building was designed and equipped for the purpose in view, and the laboratory was opened for work on the twentieth of September. It consists of seven small laboratories, each of which affords ample accommodation for two workers, and of a number of other rooms for general purposes, weighing, photographic work, optical measurements, pure-water distillation, storage of chemical and physical apparatus, and the holding of seminar meetings. A well-equipped shop in which a skilled instrument maker is regularly employed adjoins the laboratory, and in close connection with it is a chemical lecture-room and the new students' laboratory for undergraduate work in theoretical chemistry to which reference has been made in the report of the Chemical Department.

The laboratory staff for this year consists of eight research associates and assistants working under the direction of Professors A. A. Noyes, W. R. Whitney, and H. M. Goodwin.

Two graduate scholars studying for advanced degrees are also working upon researches in the laboratory. The following investigations are already in progress: The Electrical Conductivity of Aqueous Solutions at High Temperatures (up to 306° and higher) — three separate researches carried on by Dr. W. D. Coolidge, Dr. H. C. Cooper, and Mr. A. C. Melcher; the Conductivity of Fused Salts by Mr. R. Haskell; Electrical Transference Determinations with Nitric Acid by Mr. Y. Kato; the Migration and Coagulation of Colloids by Dr. J. C. Blake; the Equilibrium in Solution between Milk Sugar and its Hydrate by Mr. C. S. Hudson; the Dissociation-Relations of Sulphuric Acid at Various Temperatures by Mr. M. A. Stewart; and the Hydrolysis of Ammonium Sulphide determined by Vapor-Pressure Measurements by Mr. C. F. Sammet. The researches upon the conductivity of aqueous solutions and upon transference are being assisted by two grants of $2,000 each made to Professor Noyes by the Carnegie Institution. An extensive article describing the progress of the former research up to date has just been published. Besides these physico-chemical investigations, work is being continued with the assistance of Mr. C. S. Bryan, Jr., in developing a new system of qualitative analysis including nearly all the metallic elements. The members of the laboratory staff are giving a number of advanced lecture courses and are carrying on seminars on physico-chemical subjects, which are attended by all those connected with the laboratory. An announcement of those courses is made in the Programme of the Research Laboratory which has been issued by the Institute.

A. A. NOYES.

COURSE VI.— ELECTRICAL ENGINEERING.

The greater part of the machines and apparatus ordered for the Augustus Lowell Laboratory has been received and installed and is now in operation. The generating plant, comprising about 1200 horse-power of different types of

engines and dynamos, is used for lighting and power purposes in the various buildings of the Institute and also supplies for laboratory experiments current of any required amount and at any desired voltage. A condenser and cooling tower have been installed and will add to the economy of operation of the plant. The equipment of the department, though increased by the purchase of a number of measuring instruments and instruments of precision, is still severely taxed during the progress of thesis work and a considerable addition in instruments is needed.

The changes in the Course suggested and approved last year have already been inaugurated in the second and third years, but a further period of two years must elapse before the scheme is in full operation for the fourth year as well. There results from these changes a very considerable increase in the amount of time devoted to electrical instruction, especially to theoretical electricity, and a corresponding decrease has resulted in the time given to mechanical engineering subjects.

During the past year, in addition to excursions to local power stations and manufacturing plants, students of the fourth year visited the works of the General Electric Company at Schenectady and a small party inspected some of the large electrical stations in New York City. Although the thesis work was on the whole satisfactory, the results obtained show evident need of a greater allotment of time to this work, both from the standpoint of achievement and also to give the students opportunity for proper assimilation of the results which they obtain. It is hoped that in the ultimate arrangement of the Course the second term of the fourth year may be so planned as to allow this opportunity.

An important feature has been inaugurated this year in connection with the work in the Laboratory of Dynamo Electric Machinery. Each student is required to submit before performing any particular experiment a clear statement of the problem, a sketch of the apparatus to be used, and a brief explanation of the methods to be employed. This preliminary

sketch is examined and commented upon by the laboratory instructors in consultation with the student, and it is believed that the efficiency of the instruction will in this way be much increased. Of course this involves a very considerable addition to the work of the instructing staff. The instruction in the laboratory is also being brought into very much closer relation with that in theoretical electricity, and the introduction of a system of laboratory conferences, in which the bearing of the work on engineering practice is discussed, cannot but prove of the greatest benefit to the students.

The Journal Meetings begun last year are to be continued and the collaboration with the department of English is to be carried out along the same lines as during the year just past.

The importance of electrical engineering instruction, both lectures and laboratory work, in the scheme of other departments is fully recognized, and this department is now giving instruction in the laboratory to students in naval architecture, mechanical and mining engineering, and electro-chemistry. The handling of this increased body of students in the laboratory, together with the additional work involved in the new plan of instruction, should be met by an increase in the instructing staff of this department.

A considerable number of lectures has been given to the students of the department during the past year by distinguished engineers not connected with the Institute.

LOUIS DUNCAN.

COURSE VII.—BIOLOGY.

The activity of this department in research and publication, referred to last year, has been continued, the younger members of the staff, especially, deserving honorable mention in this connection (see list of publications beyond).

Professor Hough, who came to the Institute in 1893 as Instructor in Biology, and was soon after promoted to an assistant professorship, has resigned in order to accept the

Associate Professorship of Biology in Simmons College and to organize its Biological Department. His resignation was accepted with great regret. In his place has been appointed as instructor one of his former pupils, Dr. Percy G. Stiles, a graduate of the Biological Department of the Institute in the class of 1897, afterwards Assistant in Biology with us, and more recently a graduate student, Fellow, Assistant, and Doctor of Philosophy from the Johns Hopkins University. Dr. Stiles brings with him a good reputation as a teacher and investigator.

Mr. Samuel Cate Prescott, for some years a successful instructor in the Department of Biology, has been appointed Assistant Professor of Industrial Biology. To him, with the assistance and coöperation of Mr. William Lyman Underwood, lecturer in the Biological Department, belongs the credit of working out for the first time the bacteriological aspects of the canning industry. By their investigations Messrs. Prescott and Underwood have contributed materially to the improvement of the practical processes of canning and preserving foods. Professor Prescott has also discovered, and made known in a series of published papers, a remarkable similarity between the common intestinal bacteria and certain lactic acid bacteria, a discovery of the very first importance in the interpretation of sanitary bacteriological analyses of water and sewage.

Mr. Underwood, who is chairman of the Board of Health of Belmont, Mass., and an unpaid member of the instructing staff of this department, having made himself an authority on the mosquito nuisance and its control, especially in connection with the drainage of marshes, low-lands, clay pits, etc., has published extensively on that subject during the year. He has also recently made the important discovery, in Maine, of a large mosquito, hitherto unknown, which has been named in his honor *Eucorethra underwoodi*, by the experts of the Division of Entomology of the United States Department of Agriculture.

Dr. Weysse, instructor in Zoölogy, visited the Bermuda

Islands during the long vacation and brought home much valuable zoölogical material by which his classes will henceforward benefit.

Owing to the growth of the research work of the department and the need of better adjustment to changed conditions, the large room heretofore used as a third-year laboratory has been turned into a research laboratory and thoroughly equipped for advanced students carrying on investigations. This has involved an exchange by which the third-year classes are cared for in the former research laboratory,— an exchange which has already proved advantageous and wise. Excellent accommodations are now available in the new research room for fourteen investigators, and this amount of space is needed for graduate or special students, thesis workers and, especially, for the younger members of the staff, who have no other suitable place for their own investigations. New and larger incubators and other pieces of apparatus, especially designed for our work by Professor Prescott, have been placed in the bacteriological laboratory and in the research room.

The equipment of the department has been much improved during the year by the addition of a number of high-power microscopes of the latest pattern. More of the same kind are still greatly needed.

A Sanitary Research Laboratory and Sewage Experiment Station, made possible by the generosity of a friend of the Institute who prefers to remain anonymous, was opened on April first in modest but convenient and suitable quarters, rented for the purpose on Albany Street near the corner of Massachusetts Avenue. This site was selected chiefly because of its proximity to one of the largest of the sewers of the City of Boston, entrance into which was kindly permitted by the officers of the Sewer Department. Mixed sewage from a very large population is thus always accessible, and through a pump run by an electric motor can be obtained for experimental purposes in sufficient quantity at any hour, day or night. The property rented was formerly a large stable having connected with it a spacious yard and a small

two-story office building. The stable has been converted into a tank room, the hay loft overhead into a second tank room and a place for the storage of sewage — necessary in certain experiments,— and the office building into two laboratories, one chemical, the other biological. Some three months were required for the necessary alterations and the installation of the first experiments, but good progress has already been made and the facilities now offered for students and investigators of sewage and sewage disposal are such, it is believed, as no other educational institution possesses.

Professor Sedgwick was appointed Director of the new Laboratory and Station, Professor Porter, Consulting Engineer, Professor Talbot, Consulting Chemist, and Mr. C.-E. A. Winslow, Instructor in Sanitary Biology, Biologist in Charge. Most of the labor and responsibility of fitting up and organizing the laboratory, and making its work effective, has fallen upon Mr. Winslow. Mr. Earle B. Phelps, a graduate of the Institute in 1899 and since that time one of the staff of investigators at the Lawrence Experiment Station of the State Board of Health of Massachusetts, was appointed Research Chemist and Bacteriologist. Mr. Phelps has given his whole time to the work since February 1st, and at the recent meeting of the American Public Health Association, in Washington, presented a paper on some of the first results of his investigations of the chemistry of sewage, with a criticism of the analytical methods commonly employed. Mr. Winslow gave his entire summer to research work at the new laboratory, and Professor Prescott and several students have worked there for shorter periods Mr. G. R. Spalding has been appointed laboratory assistant, and Miss A. F. Rogers, a research assistant.

Conformably to the expressed wishes of the donor, plans have been made for the publication of a series of popular pamphlets, or leaflets, having for their object the wider dissemination of the elementary truths of sanitary science expressed in the simplest language, and it is expected that the first of these pamphlets will soon appear.

Professors Sedgwick and Hough have nearly ready for the press a work on physiology and hygiene to which they have devoted much of their vacation time for the last three years. Professor Sedgwick is also engaged in a study of the practical efficiency of the Chicago Drainage Canal and the streams into which it flows as a means of sewage purification, while acting as one of the principal advisers of the State of Missouri in its suit for an injunction, against the State of Illinois and the Sanitary District of Chicago, in the Supreme Court of the United States,— a controversy of national importance in sanitary science. Professor Prescott and Mr. Winslow will soon publish a short treatise upon the Bacteriology of Water, to which subject they have given special attention for several years; and Dr. Weysse has in the press of the Macmillan Company a Synoptic Text Book of Zoölogy, based upon methods of instruction gradually developed in work with classes in general zoölogy at the Institute.

W. T. SEDGWICK.

COURSE VIII.— PHYSICS.

The past year has been largely one of transition. The space vacated by the removal of the laboratory of electrical engineering to the Lowell Building was appropriated to the laboratories of heat measurements, physical chemistry, and electro-chemistry, together with a few rooms for research. But the great amount of time necessarily consumed in the transfer of the heavy dynamo machinery prevented much use of the space in question throughout the past year. The last of the apparatus has been removed, however, since the present school-year began, and the various rooms are or will shortly be in condition for use.

The Physico-chemical Laboratory has been transferred from Room 2 on the Clarendon Street side of the Walker Building to Room 6 on the opposite side. To it have been added two small rooms specially fitted for conductivity work,

a large dark room for vacuum tube work and the study of dielectric constants, a store-room, and a room for physical research.

The Electro-chemical Laboratory is now opened for the first time, its establishment having become imperative on account of the students in the Electro-chemical Option of Course VIII. It occupies the space vacated by the Laboratories of Physical Chemistry and Heat Measurements, together with a small section of the chemical packing room. The laboratory is 92 feet long by 30 feet wide and is divided into two parts: the first, 62 × 30, is designed and equipped for electro-chemical measurements and analysis, while the second, 30 × 30, is fitted up for technical work. The equipment of the former laboratory has been made as complete as possible with the view of offering every facility for rapid and accurate work. Each student is provided with an especially designed five and one-half foot desk with sink, suction, and gas at one end, and a large porcelain thermostat at the other. The thermostat is electrically heated and regulated, and is provided with stirrer and rotator for saturating solutions. On the front of each desk are provided four independent circuits of 2, 12½, 25, and 110 volts repectively, each wired to deliver current up to ten amperes. A large rheostat of corresponding capacity at the side of each desk is also wired directly to this switch-board. A shaft driven by an electric motor runs along the back of each desk above the switch-board and furnishes power for stirring, etc.

The desk equipment for each student is also very complete. Besides the necessary chemical equipment, a complete set of electro-chemical apparatus is provided. This includes for each student a three-scale Weston portable voltmeter, a Weston milli-voltmeter with separated shunt for reading currents, copper, silver, gas and soluble-anode voltameters, transference apparatus, complete Kohlrausch conductivity apparatus, Lippmann electrometer, potential and resistance box, normal and half electrodes, etc. The whole class is thus able to work at the same time on the subjects that are concurrently discussed

in the lectures. Specially designed constant temperature closets for electro-chemical analysis are also provided. Although ten desks were equipped the present year, (three more than were needed to accommodate the regular students in the Course), the demand for places has already exceeded the supply, owing to the unexpected number of graduate students who have elected the work.

The laboratory for applied electro-chemistry has been equipped with the view of providing all necessary facilities for illustrating typical electro-chemical processes on a fairly large scale, and for research work. The equipment includes a double current motor-generator of 25 kilowatts capacity, capable of furnishing 1000 or 2000 amperes at 25 and 12½ volts respectively. This generator supplies current for the students' desks and for electrolytic processes requiring large currents. It also serves to charge the large storage battery which has been installed for use in processes requiring large currents at very constant voltage. For processes taking place in electric furnaces at very high temperatures, but not involving electrolysis, the laboratory is further equipped with a special step-down transformer of 50 kilowatts capacity designed by Professor Derr of this department. This transformer is so constructed that several furnaces can be run simultaneously, thus enormously increasing its availability for experimental work.

The laboratory is equipped with a number of electric furnaces of various types, including those of Moissan and Borchers, and others especially constructed for experimental work. The necessary electrical instruments for measuring heavy currents and energy are also provided.

The removal of the Electrical Engineering Department has given for the first time the room needed for the development of the Laboratory of Heat Measurements as originally planned. It is now possible so to install the equipment now at hand as to have apparatus for instruction and research available in practically all fields of heat measurements.

The original plans for the laboratory, made over fifteen years ago, have steadily been developed. Beginning with a modest equipment of one or two pyrometers, a fuel combustion bomb, and several standard thermometers and comparators, located in a very small room of the laboratory, it has three times outgrown its quarters, only now to find ample space in the former dynamo room. The equipment now comprises what is without doubt the most complete collection of standard apparatus for heat measurements in existence for purposes of instruction and entirely sufficient for any purpose. In addition there is a large amount of original apparatus for instruction and research, especially of a technical nature.

The number of students taking a course in heat measurements has increased from a half dozen in 1893 to about 200 in 1903. In 1893 a small part of the time of one assistant sufficed for the instruction then given, but now the major portion of the time of Professor Norton and the entire time of one assistant are hardly sufficient for that purpose.

The laboratory has become a standardizing laboratory in many lines of heat work, and has acquired a wide reputation for certain of this work. The cramped quarters hitherto occupied have prevented a more rapid growth in this direction, and it is believed that the present relief will be a great help in such work.

The supply of electrical power, 35 kilowatts for electric furnaces, and the possibility of further supply in 15 kilowatt units leave little to be desired at present in the line of further facilities for high electric temperature furnaces.

The most urgent need at present is a small refrigerating machine for use in connection with the measurements of conductivity and specific heats of materials used in modern cold storage practice.

The special facilities of the laboratory have made it possible to do much work in the last year in research for the Insurance Engineering Experiment Station, of which one of the members of the department is the engineer. The results

of several of these researches have been published during the year.

The laboratories of Heat Measurements and of Electrochemistry are supplied with alternating current from a plant located in the former laboratory, which consists of a 30-kilowatt, 1100-volt, Thomson-Houston, single-phase alternator, belt-driven by a 50-horse-power, Thomson-Houston, direct current, 220-volt motor. The 1100-volt leads from the alternator are carried directly to both laboratories, for connection with the large transformers there used. A full complement of transformers is also provided, for supplying current at 125 cycles and 110 or 220 volts to the various laboratories and lectures.

The alternator is mounted upon the pier formerly occupied by the engine of the old dynamo plant, and the motor on the floor near by, the two making a compact and smoothly-running plant. The current actuating the motor is furnished from the plant in the Laboratory of Electrical Engineering.

The Optical Laboratory has been greatly developed during the past three years and now furnishes large facilities for undergraduate and graduate work which is carried on in immediate connection with lecture-room instruction. The equipment includes a Pulfrich refractometer, a Zeiss microscope with all accessories for a complete experimental study of the optics of the microscope; a Littrow spectroscope with echelon for spectrum investigations; an Abbé focometer for the determination of focal lengths and apertures of lenses and lens systems; Weber and Munsell photometers for photometric studies; a Koenig spectro-photometer; a Lippich-Landolt half shade polarimeter; and a Michelson interferometer with the necessary adjustments for the determination of wavelength, index of refraction, and other physical constants.

The equipment of the Laboratory of General Physics has been materially increased, chiefly in the way of duplication, in order to provide for the unusually large classes of the second and third year.

The department is in great need of a small plant for the

production of liquid air and other gases. The absence of this has rendered it impossible hitherto to study many important physical problems. Such a plant has come to be regarded as a usual adjunct to a properly equipped physical laboratory.

A considerable portion of the apparatus formerly located in the Electrical Laboratory, comprising that of a more purely technical character, has been removed to the Standardizing Laboratory of the Department of Electrical Engineering. A number of advanced electrical experiments of a physical character have been introduced.

So far as room is concerned, one of the principal inconveniences under which the department at present labors is the want of an apparatus room, in which the very large collection of apparatus belonging to it can be properly arranged so as to be easily accessible. At present this has to be stored in several rooms, so closely packed as to forbid suitable classification, and liable, moreover, to breakage in removing and replacing it. Another serious need is that of more room for the use of the instructing staff for purposes of consultation and the like. The increase in the number of instructors during the past six or eight years has caused an increasing employment of certain of the laboratory rooms, especially the acoustic laboratory, for the purpose referred to, which is, of course, detrimental to their proper use.

Co-operation in a most important study of the proposed lighting of the new buildings of the Boston Museum of Fine Arts is made possible because of special work done in the Physical Department in the past five years in the study of the problems of interior lighting. A most elaborate series of experiments on a full-sized gallery is to be carried out on a scale never before attempted, with a view to determining the best possible lighting for the exhibits in the new Museum. The physical investigation is under the care of one of the staff of the department, working jointly with the Museum committee and the architects.

CHAS. R. CROSS.

COURSE XII.— GEOLOGY.

INSTRUCTING STAFF.— The two new instructors, Dr. Johnson and Mr. Shimer, have taken up their several lines of work and are rapidly becoming familiar with our facilities in the field and laboratory. It would be entirely practicable next year for Dr. Johnson to take charge of the course in general geology, now conducted by Dr. Jaggar. Dr. Jaggar is handicapped by being obliged to give his lectures in Huntington Hall, far away from his own collections, and at an inconvenient distance from ours. Dr. Johnson could divide the class into sections, so as to be able to use the departmental lecture-room and our entire equipment. Dr. Jaggar also co-operates with us in the work in experimental geology; and it appears desirable that the latter arrangement should be continued, at least for the present, since Harvard offers laboratory facilities in this subject which it would not be wise for us to duplicate, the idea being rather to supplement their equipment.

In the division of labor in the Geological Department, it has been arranged that Dr. Johnson will have charge of nearly all the work with the Civil and Sanitary Engineers, besides giving the instruction in geological surveying and areal geology and co-operating in the field work of the Mining Engineers.

Dr. Shimer assumes the work in historical geology, paleontology and physiography, including climatology, besides assisting in the field work and the laboratory work in lithology, especially with large classes. He also has charge of the paleontological collections and of the department library.

Dr. Warren, as heretofore, has sole charge of the work in mineralogy, both elementary and advanced, and in petrography; and Professor Barton will continue to give the instruction in geology to the Boston University students.

ROOMS AND EQUIPMENT.— The most important change of the past year to be noted under this head is the transfer of the mineralogical laboratory and collections to the new build-

ing, Engineering C. Dr. Warren finds that the new laboratory is admirably adapted to the work in mineralogy; and the small room adjoining the main laboratory has been fitted up to serve as an office for members of the instructing staff, and also as a research laboratory. The equipment in instruments and apparatus for mineralogical investigation is fairly complete andis available for the use of a limited number of graduate, students.

The room vacated by Dr. Warren (13 Pierce) relieves some what the congestion in economic geology, and gives greater laboratory facilities for experimental and research work in geology.

VACATION SCHOOLS.— But little has been accomplished the past year in this direction. Last winter I visited the lead mines of southeastern Missouri and the Economic Collections of the National Museum with one student (Mr. Loughlin) and in July I conducted a party of four students in economic geology on an eight days' excursion through the valley of the Hudson, northern New Jersey and northeastern Pennsylvania.

RESEARCH AND PUBLICATION.— During the past year I have been employed by the U.S. Geological Survey in the investigation of the Geology of the Boston Basin, of the Water Resources of Long Island, and of the ground waters of Massachusetts and Rhode Island; and this work has enabled me to provide instructive employment during the summer for several of our students.

In addition to this work for the Survey, I made a special study of the local geology in its relations to the proposed Charles River Dam and my report on this work has been reprinted in the Technology Quarterly. During August and September I was engaged in studying the mining geology of Alaska, visiting the Klondike and Nome Districts.

Dr. Johnson was also employed during the summer in work for the U.S. Geological Survey on Long Island; and Mr. Shimer was engaged at Columbia University in an investigation of the paleontology of Trilobite Mountain, near Port Jervis, N.Y.

Dr. Warren has given considerable time to mineralogic and petrographic investigation; and Mr. Loughlin has prepared his thesis on the Building Stones of Boston for publication; and this excellent piece of work in economic geology will appear in an early number of the Technology Quarterly.

A Geological Journal Club with thirty members and weekly meetings has been organized and is doing good work.

W. O. CROSBY.

COURSE XIII.—NAVAL ARCHITECTURE.

The Department of Naval Architecture was moved this fall into the new building, Engineering C, where it has good accommodations, consisting of a commodious and well-lighted drawing-room large enough to provide for the probable future growth of the department; another drawing-room adequate for the needs of the U.S. naval constructors, with an adjoining room used for a private lecture room and office; also one good-sized lecture-room and a small class-room. The books belonging to the department, and also the periodicals provided for it, are kept in the general engineering library as has been the habit; this was a good arrangement when the department was housed in the engineering building, but its new location is so distant that the library is practically inaccessible both to the instructing staff and to the students. The difficulty is inadequately met by placing a few books and periodicals in the offices leading from the drawing-rooms. It is much to be desired that the students of the department may have a reading room where they may consult books and periodicals belonging to the department and read their own text-books. The only provision now possible has been made by placing tables in the drawing-rooms, with chairs and reading lamps. It is further desirable that there may be a storeroom where apparatus and other material belonging to the department can be kept when not in use.

Through the kindness of Dr. Weld the department has

been provided with a shop for making ship models, with ten benches that can accommodate twenty students at once, with machinery for preparing material, namely, a planer, a band saw, and a grinder, and with a supply of hand tools. Dr. Weld has also supplied material for making models and has provided instruction by a competent model maker. About forty students received instruction in model making last year, including some of the assistant naval constructors who are taking instruction at the Institute. The work is optional on the part of the students and they have shown an appreciation of the advantages offered. During a visit of the Chief Constructor at the Institute, he expressed much interest in the work of the model shop and a hearty commendation of the methods of work. The shop, as now arranged, is located at the Mechanical Laboratories on Garrison Street, and consists of a main room for the machinery and benches, which is sixty feet long and twenty feet wide, and an annex forty feet long and ten feet wide, half of which is used as a varnishing room and half as a stock room. It may not be out of place to say that the primary object of teaching model making is to give an adequate conception of the form of the ship which the student is designing and which he has represented by the ship's lines he has drawn. These lines may have faults that the drawing-room instructor has already pointed out, or there may be defects that are not easily discovered. In any case the model is first cut to the lines as drawn, and afterwards changes are made if expedient; thereafter ship's lines have a different meaning to the student who can interpret from them the true form of the ship. It is now the custom of ship designers, and especially of yacht designers, to have models made, and in ship-yards models are habitually used for laying out the shell plating. Advantage will be taken at the Institute of models made in the shop, for this purpose.

The department has acquired this year four additional mechanical integrators and an additional integraph, also an electric ship's log, all of which have been presented by General Paine. In all, the department now has seventeen in-

tegrators and two integraphs, which will ensure that every student will have the advantage of these important adjuncts at any time. The department has, also, a computing machine and several large slide rules. The electric log has been obtained to facilitate tests on ships at sea, a feature of the work of the department that has frequently been mentioned. The large provision of mechanical aids for computation has been sought partly that students might become familiar with them, but mainly with an idea of using to the best advantage the time that the students have assigned for ship calculations. Such calculations, when carried out numerically in a complete manner, are long and tedious and call for much practice if facility is to be attained. Even if the student could properly devote so much time to the computations, there would be danger that the fundamental principles, which are of prime importance for him, would be obscured by the mass of numerical computations. Our object has been to retain enough routine work to give proper training, and to get results which are sufficient for the purposes of instruction without undue expenditure of effort. To this end much time and thought have been given to the reduction of the labor of ship calculations without sacrificing certainty and accuracy in the results of such calculations. This has been done especially by Mr. Leland, who has devised methods of determining displacement and stability which are as good as those used in the ship-yards and require only a fraction of the time. These labor-saving devices have been of the greatest assistance in preparing and arranging the material in the possession of the department, drawings and other data, for use in teaching design. Such work is essential for the proper teaching of any kind of construction or engineering work, and is especially so for naval architecture, for which comparatively little systematic information is available.

Late in the spring a request was received from the Chief Constructor of the Navy Department that the Institute should receive five additional midshipmen and that special arrangements should be made so that they might this fall join

the class that entered a year ago. These young men as they arrived were given such work as they could do, and then, as soon as the regular work of the Institute was closed and instructors were available, special classes were formed for them in mathematics, applied mechanics, electricity and in the theory and practice of ship design. These young men are now taking the work of the senior year of Course XIII. A in a satisfactory manner. The reason for this extraordinary course was the great need of the corps of Naval Constructors for additional men as soon as they can be prepared. It was expected that the detail of additional officers to the senior class of Course XIII. A might leave us without a junior class in that Course this year, but very recently the Chief Constructor has secured the detail of three officers for whom special arrangements are requested, in order that they may be formed into a regular junior class. We have further the assurance that a class of four will be sent next fall, thus keeping up a sequence which is much to be desired.

C. H. PEABODY.

MATHEMATICS.

The work of the department has been conducted during the year along the lines indicated in the last report. Conferences of members of the department have been held at intervals, with discussion of matters of general interest and participation by members of related departments, with a view to a clearer appreciation of mutual interests. The entrance requirement in algebra has been made considerably more effective by an increase of the time allowance from two to three and one-half hours, and the division of the examination into two parts. The papers have also included problems of a practical character, as well as purely algebraic questions. The first-year course in algebra has been revised in subject-matter and sequence of work, and now includes the greater part of what was formerly given under theory of equations in

the second term. The combination of instruction by lectures and by recitations in analytic geometry and calculus has been continued with satisfactory results, and with some consequent reduction in the size of recitation sections.

At the end of the year, Professors Bartlett and Skinner were granted leave of absence for a year, and Professor Bartlett is now engaged in study and visits in Germany, paying special attention to mathematical work in the Polytechnics. Dr. Haskins has accepted appointment as instructor at Yale University, with attractive opportunities in the line of mathematical research. These changes have made it necessary to appoint three new instructors for the present year.

Professor Bailey has taken charge of the Runkle Library during Professor Bartlett's absence, Mr. George, of the course in Least Squares.

In addition to the usual course, lectures are given the present term on Potential by Dr. Mason and on the Calculus of Variations by Professor Woods, Dr. Mason, and Mr. Miller.

The American Mathematical Society held its summer meeting at the Institute August 31st and September 1st, and the usual colloquium was held during the remainder of the week, Professor Woods giving three lectures on "The Connectivity of Non-Euclidean Space."

H. W. TYLER.

MODERN LANGUAGES.

The instruction in modern languages, in the four principal courses of my department (French I., II. and German I., II.), is carried on in accordance with the views expressed by members of the Visiting Committee and with the general plan and principles indicated in the new edition of the Annual Catalogue.

An innovation, which is likely to be of some importance, is tests to be written by second, third and fourth-year students of the courses French II. and German II. once in every term; to be corrected by the instructors of the Modern Lan-

guage Department in regard to the actual rendering of the meaning of the original; and to be criticised by members of the English Department in regard to English form and expression. It is to be hoped that this arrangement will increase considerably the efficiency of the two courses French II. and German II., and will tend to improve the English style of the students, as well as their capacity for reading intelligently scientific books written in French or in German.

The new conditions regarding the entrance requirements have naturally affected the size and number of sections of the courses in elementary French and German (I.). There are now four sections of French I. with 106 students; seven sections of French II. with 179 students; nine sections of German I. with 219 students; and twelve sections of German II. with 335 students. It has not been deemed necessary this year to engage an assistant to help us in our work in German as we were obliged to do last year.

A great many students have been able to fulfil the new entrance requirements in languages, and have passed off French I. and German I. in their entrance examination. It appears, however, that the secondary schools, at present, are less well prepared to do the elementary work in German than in French.

The method of instruction in the optional advanced courses of French and German (III.) and in the Spanish classes necessarily differs from that followed in French I., II., and in German I., II., where the language taught is principally considered but a tool in regard to professional work. It gives me great pleasure to call attention to the fact that the courses in Spanish, which are expected to transmit to the students a thorough practical (reading, speaking, and writing) knowledge of Castilian, and the advanced course in French (III.), which pursues a similar aim in connection with the study of the literature and "cultural" life of France, seem to be very popular among students, and are in a flourishing condition. There are 16 students in French III. (in charge of Professor Rambeau); there are four students in the course of German Sight Read-

ing (in charge of Professor Dippold); there are five students in German III. (in charge of Professor Vogel), with aims similar to those of French III.; there are 48 students in Spanish I., three students in Spanish II. (both courses in charge of Mr. Erhardt), and seven students in Spanish III. (in charge of Professor Rambeau). Many members of the class in French III. belong to the Department of Architecture; the courses Spanish II. and III. are taken principally by students of Naval Architecture.

The Department will offer, in the second term, also optional courses in French Literature and in French Sight Reading. The demand for Italian has not been sufficiently large to warrant the formation of an Italian class.

A. RAMBEAU.

ECONOMICS.

Political economy is taken by all students of the school in the third year (students in Course X. on account of a crowded schedule in the third year take it in the fourth year). Forty-five exercises in all are given; thirty in the first term, and fifteen in the second. Originally, thirty exercises were given in the second term, but upon the introduction of the course in business law, fifteen exercises were withdrawn to provide for this subject. On account of the limited amount of time allowed, the course must be restricted in character, and in no way can it be regarded as comprehensive. We, however, lay stress upon the practical portions of the subject, giving no more attention to theory than is necessary to secure an orderly arrangement. Special stress is laid upon the descriptive matter of money and banking; at least one-third of the time is given to these and related subjects. About six exercises are devoted to railway economics, and four more to the trust question.

During the first term one exercise a week is devoted to a lecture, and in the second term all of the exercises are by lecture. The second exercise during the first term is a dis-

cussion, and, in order to make this as valuable as possible, the class is divided into sections; this year into eight, so that there is opportunity to engage students in discussion; students also answer certain questions in writing at this exercise and these papers are carefully read by Mr. Doten. After a number of these papers have accumulated, the students who appear to need special attention are requested to meet Mr. Doten in personal conference to talk over deficiencies or to straighten out misunderstandings.

Any amount of time could be spent to advantage in personal conferences, and, whatever arrangements may be made in the future in regard to the Department of Economics, I hope that a generous provision will be made for the enlargement of this part of our work.

In addition to the general course in political economy, a special course is given to students in Course VI. in the fourth year on economics of corporations; this is a lecture course of fifteen exercises; no time is given to students for preparation. The topics included are: development of corporations, forms of securities issued, analysis of a corporation account, restrictions in Massachusetts upon issue of securities, position of quasi-public corporations concerned with the industrial application of electricity, taxation of corporations, street railway franchises and control of electric lighting.

A third brief course consisting of fifteen exercises on vital statistics is given to students of Course VII., fourth year. The main object of this course is the interpretation of registration reports and census mortality statistics.

I should like to call attention to the desirability of securing special instruction in accounting. I believe that such a course would be useful for a large number of students at the Institute who are likely to have close relations with the business side of manufacturing and transportation industries. I hope that such a course can be provided for in the department of economics when the new courses are substituted in the place of modern languages in the third year.

DAVIS R. DEWEY.

ENGLISH.

The English Department has during the year continued work along the lines indicated in the Report of last year. This has included the extension of first-year English through the second term, and a large increase of written matter from the various departments connected with the special work of each. The first-year English of the second term combined composition with special preparation for second-year English Literature. Readings were given to the classes, and an effort was made to develop greater intelligence in reading and in comprehending literature. The written work given in connection with the subjects taken up in other courses, much of it coming in the later years of student life, is proving a valuable means of training, especially that which is intimately connected with technical instruction. The students have responded admirably to this requirement and have shown in connection with it much interest and appreciation. The English Department corrected last year 368 translations, 260 memoirs from the students in Mining Engineering, 39 from students in Electrical Engineering, 31 from those in Civil Engineering, 27 from students in Architecture, and 16 reports of Colloquiums. Many of these were of from five to ten pages, and a number were of a greater length still. The only change in the force during the year has been that made necessary by the resignation of Mr. R. G. Valentine, the appointment of Mr. C. H. L. Johnston as assistant. In connection with the work of the department it is of interest that the use of books and periodicals in the General Library seems constantly to increase.

ARLO BATES.

HISTORY.

The instruction in history is of three kinds: first, that given to all regular students of the Institute; second, that given as required subjects to students of certain Courses; third, optional subjects in those Courses.

Under the first head are included United States history and European history since 1815. In United States history about one-half of the time is devoted to an advanced study of certain selected topics, with special reference to the political, industrial, and social development of the country, leading up to the study, occupying the other half of the time, of the United States of today and of its government, together with some attention to municipal government.

In the European history so much ground needs to be covered that the main stress is confined to a consideration of the governments, politics, and international relations, of the leading European nations, with enough of the history of each country to make clear the origin and meaning of existing institutions.

The principal object of these two courses is to enlarge the student's knowledge of the world of the last one hundred years and of today, to broaden his intellectual horizon, to stimulate his interest in the practical problems of public life; in a word, to provide a training for good citizenship.

Of the subjects required in particular Courses, the most important is the history of European civilization and art, designed especially for students in Architecture. This is so valuable in itself, so well presented, and so fully illustrated with lantern slides, that it might profitably be taken by many students to whom it is not now open; and indeed a somewhat abridged treatment of the subject will be offered as a third-year option in the time set free by the change in entrance requirements in modern languages.

All of the foregoing subjects are likewise taken by students in the General Course who also have, either as required or as optional studies, courses covering the most important features of mediæval and modern history.

In the time to be set free in the third year, it is proposed to offer, in addition to the outlines of European civilization and art already referred to, courses in the history of important epochs and also courses of a specially practical nature, such as national government, municipal government, coloni-

zation and colonial problems, and the elements of international law.

Closely allied with the subject of history is that of government, and in this field instruction is given in comparative politics, municipal government, and international law.

Large use is made of specially prepared maps and diagrams; particular pains are taken to make the instruction in history as valuable as possible for engineering students, and to meet their special needs as completely as can be done in the limited amount of time available for the study of the subject.

CHARLES F. A. CURRIER.

MECHANIC ARTS.

The total number of students receiving instruction in the Mechanical Laboratories is three hundred and eighty-two. Some take instruction in more than one class, the numbers in the several subjects given this term being as follows: —

Carpentry and Wood Turning, II. and X.	110
Joinery and Pattern Work, VI.	38
Forging, II. and XIII.	114
Machine-tool Work, II. and XIII.	88
Metal Turning, VI. and VIII.	48
Pipe Fitting, XI.	4
Total in classes	402
Students taking work in two or more classes and counted more than once	20
Total number of students	382

The total number of students taking work in the mechanic arts since 1897–98 is as follows: —

1897–98	210	1901–02	294
1898–99	231	1902–03	347
1899–00	238	1903–04	382
1900–01	272		

SUMMER SCHOOL.— The total number of students attending the summer school in mechanic arts was smaller than usual last summer, no classes in carpentry, wood-turning, or pattern making being held on account of the very small number of applicants.

The numbers of students attending the various classes last June were as follows: —

Forging, Mr. Lambirth	15
Metal Turning, Mr. Smith	2
Chipping and Filing, Mr. Smith	8
Machine-tool Work, Mr. Smith	14
Total	39

The numbers attending the summer school since June, '98, are as follows: —

June, '98	48	June, '01	29
" '99	61	" '02	55
" 1900	52	" '03	39

CHANGES AND ADDITIONS TO EQUIPMENT. MACHINE-TOOL LABORATORY.— Seven engine lathes and a centering machine have been added to the equipment of the Machine-tool Laboratory. Two old engine lathes have been sold and replaced by new machines. It is now possible to accommodate classes of thirty students in machine-tool work instead of twenty-three as formerly, but, even with this increased equipment, several students had to be refused admission to the classes this year. An additional planer and drill press are very much needed to carry on the work successfully.

FILING LABORATORY.— To make room for the increased equipment of the Machine-tool Laboratory, the Filing Laboratory was transferred to a room on the second floor of the laboratory building, which necessitated the purchase of an additional tool-grinder. This laboratory is now arranged, as formerly, to accommodate classes of thirty-two students.

WOOD-WORKING AND FORGING LABORATORIES.— In the Wood-working Laboratory two old sets of planes have been

replaced by the best modern tools. The Forging Laboratory has had its equipment thoroughly repaired and all is now in fair condition, considering its twenty years' use. A renewal of this equipment to bring it up to date is very desirable. Both departments are, with the present arrangement of the work, easily caring for all of the students applying.

Instruction rooms, similar to that of the Machine-tool Laboratory, are very much needed in both departments and I earnestly recommend that such rooms be provided as soon as can be.

With the possible exception of the Machine-tool Laboratory, where probably two or three more lathes and some other general tools might well be added to accommodate two to three more students, it is believed that the classes are as large as they should be to be successfully cared for by our present staff. The foundry work might well be developed and made more important than now, being a short course and optional only. The laboratory facilities are now taxed to their utmost and, should the numbers continue to increase, more room will be needed.

The instructing staff now numbers four instructors and five assistants.

PETER SCHWAMB.

THE LIBRARIES.

The total number of the additions to the Library during the year 1902–3 has been 4,768, of which 1,501 were received by purchase, 916 from the binding of periodicals and books received in parts (not previously counted), and 2,351 were gifts. The net increase in the size of the library during the academic year 1902–1903, after deducting losses and books counted twice, amounts to 3,941 volumes, 961 pamphlets, and 195 maps. The distribution and cost of these is shown in the following table: —

TABLE OF THE NET ACCESSIONS FOR THE YEAR 1902–03, WITH THE COST OF THE SAME AND THE TOTAL CONTENTS OF THE LIBRARIES OF THE INSTITUTE, SEPT. 30, 1903.

LIBRARIES.	Net Increase.				Total Contents.	
	Volumes.	Pamphlets.	Maps.	Cost.	Volumes.	Pamphlets and Maps.
General	183	388	1	$202.56	5,449	4,475
English	243	4		205.26	3,111	44
Military Science	7	0		9.90	322	7
Walker Memorial Library,	225	0			225	0
Totals General Library,	658	392	1	$417.72	9,117	4,526
Architecture	192	5		547.40	3,328	233
Biology	102	68		202.24	2,781	562
Chemistry	363	38		771.85	9,059	1,708
Electrical Engineering	645	21		663.71	645	21
Engineering	719	126	1	1,171.96	11,579	4,180
Geology	125	99	192	128.66	2,409	1,404
History and Economics	412	60		288.58	11,637	3,447
Mathematics	83	10		154.57	1,315	208
Mining	233	61		342.20	3,468	567
Modern Languages	98	2	1	101.78	1,079	27
Physics	268	79		530.36	7,187	942
Margaret Cheney Reading Room	43				668	13
Totals	3,941	961	195	$5,320.83	64,272	17,838

With these additions the total contents of the library becomes 64,272 volumes and 17,838 pamphlets.

The number of serial publications received regularly by the Institute during the year 1902–1903 was 930, not including a large number of official reports and bulletins, school catalogues, and the like, which are also received regularly and duly recorded and catalogued. The following table shows the distribution of the serials, exclusive of most of the official reports: —

TABLE OF PERIODICALS AND OTHER SERIAL PUBLICATIONS RECEIVED DURING THE YEAR 1902–03.

LIBRARIES.	Number Received.					Estimated Cost.			
	Gifts.	Charged to Department.	Periodical Account.		Totals.	Department Accounts.	Periodical Account.		Totals.
			Exch.	Subs.			Exch.	Subs.	
General	40	18	15	26	99	$56.22	$30.00	$78.89	$165.11
Architecture	7	10	3	34	54	40.32	6.00	160.98	207.30
Biology	7	10	18	34	69	42.44	36.00	205 30	283.74
Geology	12	3	3	6	24	19.75	6.00	27.21	52.96
Chemistry	15	36	16	30	97*	116.46	32.00	155.78	304.24
Electrical Engineering	4	16	7	6	33	65 29	14.00	31.15	110.44
Engineering	28	57	68	61	214	160.01	136.00	254.55	550.56
History and Economics	55	48	2	42	147	77.64	4.00	138.74	220.38
Mathematics	—	1	—	17	18	.74	—	66.54	67.28
Mining	9	13	31	22	75	34.49	62.00	95.61	192.10
Modern Languages	—	2	—	18	20	3.12	—	96.11	99.23
Physics	13	11	23	21	68	44.85	46.00	96.02	186.87
Walker Memorial Library	12	—	—	—	12	—	—	—	—
Totals	202	225	186	317	930	$661.33	$372.00	$1,406.88	$2,440.21

There were added to the general catalogue during the year 4,776 cards, making the total number of cards in the catalogue 60,607. The orders for new books amounted to 1,244 items, and there were issued for binding 1,227 orders. In five of the libraries the circulation of books for home use during the year was as follows: —

General library	1,423	volumes
Engineering library	1,183	"
Chemical library	1,665	"
Mining library	1,577 †	"
Biological library	325	"

These statistics of circulation show an increase in the use of the books except in the Chemical Library where there is a slight decrease.

Through the generosity of a graduate of the Institute there has been established a library of books on athletics, out-door sports, personal hygiene, and kindred subjects, to be placed in

* Not including experiment station reports.

† This number includes books used in the library.

the Walker Memorial. This collection of books, which at the end of the fiscal year numbered 225 volumes, is kept at present in the General Library. The donor has also subscribed for 12 periodicals similar in character to the books, which are placed with the other periodicals in the General Library. Other gifts which deserve special mention are 42 large photographs of Rocky Mountain scenery given for the geological collection by Mrs Rogers, who has also continued her annual gift of periodicals; from Mrs. E. D. Cheney a set of the works of Charles Lamb, the works of Emerson, the Poets of Transcendentalism by G. W. Cooke, and the poetical works of John Keats; from Mr. J. B. Millet, 12 beautifully illustrated volumes on the history, arts, and literature of Japan and China; from Mr. Paul Gerhardt, Theatres, their Safety from Fire and Panic, Wasserstrassen u. Eisenbahnbau, 4 volumes, and five other German works on railroads; from Mr. Spaulding Bartlett, *Journal of the Society of Chemical Industry*, 7 vols., *Färber-Zeitung*, 4 vols., *Journal American Chemical Industry*, 2 vols., and *Deutsche Färber-Zeitung*, 1 vol. Other valuable gifts have been received from Mr. Timothy T. Sawyer, Mr. Thomas W. Lawson, Professor Talbot, *The Technology Review*, Mrs. Henry Draper, Miss Helen M. Winslow, and from the United States Government through the courtesy of our representatives in the Senate and House of Representatives. A bust of the distinguished civil engineer, Loammi Baldwin (1745–1807), has been placed in the Engineering Library through the generosity of the sculptor, Mr. Baldwin Coolidge.

ROBERT P. BIGELOW.

THE SOCIETY OF ARTS: REPORT OF THE SECRETARY.

To the President of the Institute:

Sir,— On behalf of the Executive Committee, I have the honor to present the annual report of the Society of Arts for the year May 8, 1902, to May 22, 1903.

The first meeting of the Society of Arts for the present year was held on October 9, 1902. Fourteen meetings have been held, with an average attendance of one hundred and eighty-four.

During the past year the unusual interest in the meetings of the Society which has been shown in the past few years has continued. An effort has been made to have the addresses given before the Society cover a wide range of subjects. As a consequence, nearly all the students in the Institute have had an opportunity to hear a man who is an authority in the subject in which they are preparing themselves for the future.

The following papers have been read: —

"Long Distance Electric Railroading." Professor Louis Duncan, Director of the Department of Electrical Engineering of the Institute.

"The Identification of our Woody Plants in Winter." Mr. John G. Jack, of the Arnold Arboretum.

"The Art of Lithography." Mr. George H. Bartlett, Principal of the Massachusetts Normal Art School.

"The Designing of Small Racing Yachts." Mr. W. Starling Burgess.

"A Substance with Remarkable Optical Properties, and a Screen Transparent to Ultra Violet Light Only." Professor R. W. Wood, of Johns Hopkins University.

"The Coast Survey and its Work." Mr. O. H. Tittmann, Superintendent of the United States Coast and Geodetic Survey.

"The Reclamation of the Arid Public Lands." Mr. F. H. Newell, Chief Engineer, United States Geological Survey.

"Martinique and Mt. Pelée." Mr. George Kennan.

Exhibition of Some New Apparatus for Illustrating Certain Electro-Magnetic Phenomena. Professor Louis Derr, of the Institute.

"Government Architecture." Mr. J. Knox Taylor, Supervising Architect, Treasury Department.

"The Composition of Sewage with Relation of Problems of Disposal." Mr. George W. Fuller, Sanitary Expert, New York City.

"The Charles River Dam." Mr. R. H. Dana.

"Some Problems to be Solved in the Building of the Perfect Steam-propelled Automobile." Mr. Francis E. Stanley.

"A Reconnaissance in the Rocky Mountains of British Columbia." Mr. Howard W. DuBois, Mining Engineer, Philadelphia.

At the beginning of the year the Associate Membership was three hundred and sixty-seven. Of these members, three have died, eight resigned, and six have been elected, making the present membership three hundred and sixty-two. There are thirty-seven Life Members..

The *Technology Quarterly* has appeared regularly during the year under the editorship of Dr. Bigelow, with the advice and counsel of the Publication Committee. There have appeared in all twenty-eight articles besides the Proceedings of the Society. A new feature introduced this year is a series of Book Reviews, which, it is hoped, will add interest to the *Quarterly*, and will further extend the influence of the Institute and members of the Instructing Staff. We are also indebted for valuable contributions to members of our Alumni, namely, Gerard H. Matthes, William Lincoln Smith, G. C. Whipple, and Earle B. Phelps.

At the forty-first annual meeting of the Society, which was held on May 22, 1903, the following named gentlemen were elected officers of the Society for the year 1903–1904. Executive Committee: George W. Blodgett, Edmund H. Hewins, Charles T. Main, James P. Munroe, and A. Lawrence Rotch. Secretary: James F. Norris.

Respectfully submitted,

J. F. NORRIS, *Secretary.*

JANUARY 30, 1904.

PART III.

TITLES OF PAPERS PUBLISHED BY MEMBERS OF THE INSTRUCTING STAFF.

CHEMISTRY AND CHEMICAL ENGINEERING.

H. P. TALBOT.— Secondary School Chemistry from the College Stanpdoint. *Proccedings of the National Educational Association*, 1903, p. 877.

A. A. NOYES.— A System of Qualitative Analysis Including Nearly All the Metallic Elements. Part I. Preparation of the Solution. *Technology Quarterly.*

A. A. NOYES.— Interpretation of the Scheme of Qualitative Analysis with the Help of the Ionic Theory and the Mass-Action Law.

Report of Fifteenth Meeting of National Educational Association of Chemistry Teachers. 1903.

W. H. WALKER.— Concentration Changes in the Electrolysis of Brine. *Proceedings of the American Electrochemical Society*, Vol. 3, p. 177.

W. H. WALKER.— Electrolytic Production of Bleaching Liquor. *Electrochemical Industry*, Vol. I. p. 439.

W. H. WALKER.— Electrometallurgy of Gold. *Proceedings of the American Electrochemical Society*, Vol. 3, p. 47.

A. H. GILL and C. G. TUFTS.— Does Cholesterol Occur in Maize Oil? *Journal of the American Chemical Society.* Vol. 25, p. 251.

A. H. GILL and C. G. TUFTS.— Sitosterol, a Possible Test for Maize Oil. *Journal of the American Chemical Society*, Vol. 25, p. 254.

A. H. GILL and C. G. TUFTS.— Does Cholesterol Occur in Olive Oil? *Journal of the American Chemical Society*, Vol. 25, p. 498.

A. H. GILL and C. C. JOHNSON.— A Comparison of Various Tests Applied to Paints Used for the Protection of Iron. *Technology Quarterly*, Vol. 16, p. 32.

A. H. GILL.— A Short Handbook of Oil Analysis. Third Edition. 8vo. pp. 159.

W. R. WHITNEY.— The Electrolysis of Water. *Journal of Physical Chemistry*, Vol. 7, p. 190.

W. R. WHITNEY.— The Corrosion of Iron. *Journal of the American Chemical Society*, Vol. 25, p. 394.

W. R. WHITNEY — Free Ions in Aqueous Solutions. *Transactions of the American Electrochemical Society*, Vol. 3, p. 101.

HENRY FAY, A. W. HIGGINS, and F. W. COBURN.— A Study of the Relations between the Microstructure, the Heat Treatment, and the Physical Properties of Axle Steel. *Technology Quarterly*, Vol. 16, p. 4.

JAMES F. NORRIS and LLORA R. CULVER.— The Action of Zinc on Triphenylchlormethane. *American Chemical Journal*, Vol. 29, p. 120.

JAMES F. NORRIS and D. R. FRANKLIN.— The Action of Zinc on Benzoyl Chloride, *American Chemical Journal*, Vol. 29, p. 141.

JAMES F. NORRIS and W. C. TWIEG.— The Condensation of Carbon Tetrachloride with Chlorbenzene by Means of the Friedel and Crafts Reaction. *American Chemical Journal*, Vol. 30, p. 392.

JAMES F. NORRIS.— The Action of Zinc on Triphenylchlormethane (Second Paper). *American Chemical Journal*, Vol. 29, p. 609.

F. J. MOORE.— Some Derivatives of p-Sulfocinnamic Acid. *Journal of the American Chemical Society*. Vol. 25, p. 622.

ELLEN H. RICHARDS.— Alum in Water. A. H. Low's modification of the logwood test. *Technology Quarterly*, December, 1902.

ELLEN H. RICHARDS.— Notes on the Potable Waters of Mexico. *Transactions of the American Institute of Mining Engineers*, Vol. 32.

ELLEN H. RICHARDS.— Water supplies of south-eastern Alaska. *Technology Quarterly*, December, 1903.

ELLEN H. RICHARDS.— Water Supplies in the Black Hills of South Dakota. *Technology Quarterly*, December, 1903.

A. G. WOODMAN.— The Determination of Atmospheric

Carbon Dioxide by the Walker Method. *Journal of the American Chemical Society*, Vol. 25, p. 150.

GEO. W. ROLFE and H. W. GEROMANOS.— Notes on Hydrolysis of Starch by Acids. *Journal of the American Chemical Society*, Vol. 25, p. 1003.

GEO. W. ROLFE and I. T. HADDOCK.— The Presence of Maltose in Acid-Hydrolyzed Starch Products. *Journal of the American Chemical Society*, Vol. 25, p. 1015.

M. S. SHERRILL.— Ueber die Komplexbildung und einige physiko-chemische Konstanten der Quecksilber-Haloide. *Zeitschrift für physikalische Chemie*, Vol. 43, p. 705.

J. W. BROWN.— Der katalytische Beschleunigung der Oxydation von Naphtalin und Anilinsulfat mittels heisser Schwefelsäure. Dissertation. Heidelberg, Germany. 1903.

R. B. EARLE (with C. LORING JACKSON).— On Certain Derivatives of Picric Acid. *American Chemical Journal*, Vol. 29, p. 212.

R. B. EARLE (with C. LORING JACKSON).— On Colored Substances Derived from Nitro Compounds. *American Chemical Journal*, Vol. 29, p. 89.

R. B. EARLE (with C. LORING JACKSON).— On Symmetrical Dinitrobenzolsulphonic Acid. *American Chemical Journal*, Vol. 29, p. 216.

R. B. EARLE (with JULIUS STIEGLITZ).— The Beckmann Rearrangement (III. and IV.) *American Chemical Journal*, Vol. 30, pp. 399 and 412.

RESEARCH LABORATORY OF PHYSICAL CHEMISTRY.

A. A. NOYES and W. D. COOLIDGE.— The Conductivity of Aqueous Solutions at High Temperatures. 1. Description of the Apparatus. Results with Potassium and Sodium Chloride up to 306°. *Proceedings of the American Academy of Arts and Sciences*, Vol. 39, pp. 163–219, 1903. *Zeitschrift für physikalische Chemie*, Jubelband, 1903.

J. C. BLAKE.— Untersuchung und Vergleichung einiger isomorphen Trifel Thiocyanate, *Zeitschrift für Krystallo-*

graphie, Vol. 37, pp. 103–109; The Colors of Allotropic Silver, *Am. Jour. Sci.*, Vol. 16, pp. 282–288; On Colloidal Gold: Adsorption Phenomena and Allotropy, *Am. Jour. Sci.*, November, 1903; Note on the Composition of Bredig's Silver Hydrosols, *Am. Jour. Sci.*, November, 1903; The Behavior of Colloidal Gold in Solution toward the Electric Current and toward Electrolytes, *Am. Jour. Sci.*, December, 1903.

C. S. HUDSON.— Ueber die Multirotation des Milchzuckers. *Zeitschrift für physikalische Chemie*, Vol. 44, pp. 487–494, 1903; Die gegenseitige Löslichkeit von Nikotin und Wasser, *Zeitschrift für physikalische Chemie*, Vol. 46, 1903.

Some additional publications are included in the list of those of the Chemical Department.

BIOLOGY.

W. T. SEDGWICK (with THEODORE HOUGH),—What Training in Physiology and Hygiene may we Reasonably Expect of the Public Schools? *Science*, N.S., Vol. 18, No. 455, pp. 353–360, September, 1903.

W. T. SEDGWICK (with C.-E. A. WINSLOW).— On the Relative Importance of Public Water Supplies and Other Factors in the Causation of Typhoid Fever. *Transactions of the American Public Health Association*, Vol. 28, 1902.

THEODORE HOUGH.— On the Correlation of the Work of Physical Training with Instruction in Personal Hygiene. Published by the Boston Normal School of Gymnastics, Boston, 1903.

THEODORE HOUGH (with W. T. SEDGWICK).— What Training in Physiology and Hygiene may we Reasonably Expect of the Public Schools? *Science*, N.S., Vol. 18, No. 455, pp. 353–360, September, 1903.

S. C. PRESCOTT.— On Certain Precautions Required in Making and Interpreting the So-called "Colon Test" for Potable Waters. *Public Health*, Vol. 28, pp. 413–419. *Medicine*, Vol. 9, No. 1, 1903.

S. C. PRESCOTT.— Further Evidence of the Apparent

Identity of Bacillus Coli and Certain Lactic Acid Bacteria. *Science*, Vol. 17, No. 427.

S. C. PRESCOTT.— The Importance of Science and Investigation in the Development of the Canning Industry. *American Grocer*, Vol. 69, No. 34. *The Trade*, Vol. 25, No. 27. *Canner and Dried Fruit Packer*, Vol. 14, Special Number, February, 1903.

S. C. PRESCOTT (with W. L. UNDERWOOD and others).— Science and Experiment as Applied to Canning. 1 Vol., pp. 172. Chicago, 1903.

R. P. BIGELOW.— Articles on "Ovum," "Parthogenesis," "Reduction-Division," "Reproduction," and "Reversion," in the *Reference Handbook of the Medical Sciences* (Revised Edition), Vol. 6, William Wood & Co., New York, 1903.

R. P. BIGELOW (with ELEANOR P. RATHBUN).— On the Erosion of the Shell of *Littorina litorea*. *Science*, N.S., Vol. 17, No. 430, March 27, 1903, p. 494.

R. P. BIGELOW (with ELEANOR P. RATHBUN).— The Variations of Some Acquired Characters. *Science*, N.S., Vol. 17, No. 430, March 27, 1903.

R. P. BIGELOW (with ELEANOR P. RATHBUN).— On the Shell of *Littorina litorea* as Material for the Study of Variation. *American Naturalist*, No. 435, March, 1903, pp. 171–183.

A. W. WEYSSE.— The Perforation of a Vein by an Artery in the Cat. *American Naturalist*, Vol. 37, No. 439, 1903.

C.-E. A. WINSLOW (with A. G. WOODMAN and P. HANSEN).— A Study of Self-purification in the Sudbury River. *Technology Quarterly*, Vol. 15, No. 2, June, 1902.

C.-E. A. WINSLOW (with Miss M. P. HUNNEWELL). A Study of the Distribution of the Colon Bacillus of Escherich and of the Sewage Streptococci of Houston in Polluted and Unpolluted Waters. *Journal of Medical Research*, Vol 3, No. 3, December, 1902.

C.-E. A. WINSLOW (with W. T. SEDGWICK). On the Relative Importance of Public Water Supplies and Other Factors in the Causation of Typhoid Fever. *Transactions of the American Public Health Association*, Vol. 28, 1902.

C.-E. A. WINSLOW.— The War against Disease. *Atlantic Monthly*, January, 1903.

C.-E. A. WINSLOW.— Reviews of Vital Statistics. *Quarterly Publications of the American Statistical Association*, Vol. 8, March, 1903.

C.-E. A. WINSLOW.— The Case for Vaccination. *Science*, N.S., Vol. 18, No. 447, July, 1903.

C.-E. A. WINSLOW (with C. P. NIBECKER). The Significance of Bacteriological Methods in Sanitary Water Analysis. *Technology Quarterly*, Vol. 16, No. 3, September, 1903.

W. L. UNDERWOOD.— The Canning Industry in New England. 25th Anniversary Number of *The Trade*, Baltimore, Md.

W. L. UNDERWOOD (with S. C. PRESCOTT and others).— Science and Experiment as Applied to Canning. 1 vol., 172 pp. Chicago, 1903.

W. L. UNDERWOOD.— The Mosquito Nuisance and How to Deal with It. A pamphlet illustrated with 12 photographs taken from life. Prepared for the Board of Health of Belmont, Mass. Boston, 1903.

W. L. UNDERWOOD.— A New Mosquito. *Science*, N.S., Vol. 18, No. 449, Aug. 7, 1903.

W. L. UNDERWOOD.— Mosquitoes and Suggestions for their Extermination. *Popular Science Monthly*, Vol. 63, No. 5, p. 454, September, 1903. Illustrated with 15 photographs taken from life.

W. L. UNDERWOOD.— The House Fly as a Carrier of Disease. Illustrated by photographs from life. *Country Life in America*, Vol. 4, No. 2, p. 158, June, 1903. Republished for popular distribution by George Francis Peabody, Esq., of New York, after having been rewritten, enlarged, and simplified. *Literary Digest*, Vol. 27, No. 17, p. 543, Oct. 24, 1903.

G. W. FIELD.— A Report upon Certain Biological Problems connected with the Proposed Charles River Dam. Report of Committee on Charles River Dam, Appendix No. 6, Boston, 1903.

P. G. STILES (with GRAHAM LUSK).— On the Formation

of Dextrose in Metabolism from the End-products of a Pancreatic Digest of Meat. *American Journal of Physiology.* Vol. 9, No. 6, August, 1903.

P. G. STILES (with GRAHAM LUSK).— On the Action of Phlorhizin. *American Journal of Physiology*, Vol. 10, No. 1, September, 1903.

P. G. STILES.— Theories of Sleep. *Popular Science Monthly*, September, 1903.

FREDERICK A. WOODS.— The Correlation between Mental and Moral Qualities. *Popular Science Monthly*, October, 1903.

GEOLOGY.

W. O. CROSBY.— The Hanging Valleys of Georgetown, Colorado. *Technology Quarterly*, Vol. 16, pp. 41–50; *American Geologist*, Vol. 32, pp. 42–48.

W. O. CROSBY.— A Study of the Geology of the Charles River Estuary and Boston Harbor, with special reference to the building of the proposed dam across the tidal portion of the river. *Technology Quarterly*, Vol. 16, pp. 64–92.

W. O. CROSBY.— Structure and Composition of the Delta Plains formed during the Clinton Stage in the Glacial Lake of the Nashua Valley. (To be continued.) *Technology Quarterly*, Vol. 16, pp. 240–254.

D. W. JOHNSON.— The Geology of the Cerrillos Hills, New Mexico: Part I. The General Geology of the Cerrillos Hills. *School of Mines Quarterly*, April and July, 1903.

Part II. The Paleontology of the Cerrillos Hills. *School of Mines Quarterly*, January, 1903.

Part III. The Petrography of the Cerrillos Hills. *School of Mines Quarterly*, October, 1903. (In press.)

D. W. JOHNSON.— Jurassic Fossils from Durango, Mexico. *American Geologist*, December, 1902.

D. W. JOHNSON.— Block Mountains in New Mexico. *American Geologist*, March, 1903.

H. W. SHIMER.— Fall Excursions of the Geological De-

partment, Columbia University. *American Geologist*, Vol. 31, January, 1903.

H. W. SHIMER.— Columbia University Summer School on Lake Champlain. *American Geologist*, Vol. 32, August, 1903.

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PART IV.

STATISTICS.

THE CORPS OF INSTRUCTORS.

The Catalogue of this year shows the number of instructors of all grades to be 186, inclusive of those concerned with the mechanic arts, but exclusive of those who are announced as lecturers for the year only. The addition of these raises the total to 227. This year's Catalogue will show an increase of two in the number of lecturers and some changes in the grades of professors and instructors. Without counting lecturers, the number of instructors to that of students bears the proportion of one to eight and two-tenths. The following table shows the distribution among the several classes of instructors, in comparison with last year: —

	1902–03.	1903–04.
Professors	28	30
Associate Professors	12	14
Assistant Professors	25	25
Instructors	54	66
Assistants	46	51
Lecturers	39	41
Total	204	227

STUDENTS AND GRADUATES.

The registration of this year, as shown by the Catalogue amounts to 1,528. The following table shows the registration of successive years from the foundation of the Institute: —

Year.	No. of Students.	Year.	No. of Students.
1865–66	72	1885–86	609
1866–67	137	1886–87	637
1867–68	167	1887–88	720
1868–69	172	1888–89	827
1869–70	206	1889–90	909
1870–71	224	1890–91	937
1871–72	261	1891–92	1,011
1872–73	348	1892–93	1,060
1873–74	276	1893–94	1,157
1874–75	248	1894–95	1,183
1875–76	255	1895–96	1,187
1876–77	215	1896–97	1,198
1877–78	194	1897–98	1,198
1878–79	188	1898–99	1,171
1879–80	203	1899–1900	1,178
1880–81	253	1900–1901	1,277
1881–82	302	1901–1902	1,415
1882–83	368	1902–1903	1,608
1883–84	443	1903–1904	1,528
1884–85	579		

STUDENTS BY CLASSES.

The aggregate number of students for 1903–04 is divided among the several classes, as follows: —

Fellows	5
Graduate students, candidates for advanced degrees	13
Regular students, Fourth Year	238
" " Third "	238
" " Second "	289
" " First "	255
Special students	490
Total	1,528

Assigning the special students to classes, according to the predominant studies pursued by them, we reach the following division of the whole body among the several years: —

Class.	Regular.	Special.	Total.
Fellows and Graduates of the M.I.T.	18	—	18
Fourth Year	238	84	322
Third Year	238	144	382
Second Year	289	169	458
First Year	255	93	348
Total	1,038	490	1,528

THE COURSES OF INSTRUCTION.

The following table presents the number of the regular students in the second, third, and fourth years, by courses: —

Year.	Civil Engineering.	Mechanical Engineering.	Mining Engineering and Metallurgy.	Architecture.	Chemistry.	Electrical Engineering.	Biology.	Physics.	General Course.	Chemical Engineering.	Sanitary Engineering.	Geology.	Naval Architecture.	Total.
4th Year Class	40	42	28	21	16	35	2	13	5	7	2	–	27	238
3d " "	49	42	26	11	24	41	1	3	1	11	6	–	23	238
2d " "	43	77	37	21	15	50	1	7	–	9	6	1	22	289
Total	132	161	91	53	55	126	4	23	6	27	14	1	72	765

The following table shows the figures of the total line in the foregoing table, in comparison with the corresponding figures for the next ten preceding years :—

Year.	Civil Engineering.	Mechanical Engineering.	Mining Engineering and Metallurgy.	Architecture.	Chemistry.	Electrical Engineering.	Biology.	Physics.	General Course.	Chemical Engineering.	Sanitary Engineering.	Geology.	Naval Architecture.	Total.
1893	78	97	22	50	39	141	4	10	19	31	10	2	8	511
1894	88	111	19	48	50	137	5	9	19	35	13	1	20	556
1895	88	118	25	67	59	126	7	11	14	25	10	3	22	575*
1896	99	117	24	65	66	106	7	11	11	34	8	..	25	573*
1897	109	119	38	71	60	90	8	9	10	36	7	1	26	578
1898	93	108	52	64	64	94	6	8	12	38	7	1	33	574
1899	99	113	60	53	58	84	8	7	11	30	14	1	38	575*
1900	89	127	69	53	50	87	6	4	8	34	17	1	38	582
1901	102	129	76	40	35	96	6	13	9	30	14	1	39	590
1902	129	133	83	43	58	118	2	20	9	30	12	1	65	703
1903	132	161	91	53	55	126	4	23	6	27	14	1	72	765

The following table shows, by classes and by courses, the number of regular students who have registered themselves as electing to distribute the required studies and exercises over the period of five years :—

Year.	Total.	Course.												
		I.	II.	III.	IV.	V.	VI.	VII.	VIII.	IX.	X.	XI.	XII.	XIII.
1st . . .	6	–	–	–	–	–	–	–	–	–	–	–	–	–
2d . . .	18	3	7	–	–	2	1	–	–	–	2	–	1	2
3d . . .	21	2	5	3	1	–	2	1	2	1	1	–	–	3
4th . . .	7	–	1	1	–	–	1	–	1	–	–	1	–	2
5th . . .	9	2	1	1	2	–	1	–	–	–	–	1	–	1
	61	7	14	5	3	2	5	1	3	1	3	2	1	8

The following is the number of students, either regular or special, pursuing certain leading branches of study, in each of the four years :—

* Deducting those counted twice.

	First Year.	Second Year.	Third Year.	Fourth Year.	Total.
Mathematics	346	430	186	6	968
Chemistry	352	64	129	102	647
English	315	376	6	8	705
French	102	107	70	–	279
Physics	—	443	347	119	909
German	144	199	161	3	507
Mechanic Arts . . .	—	212	70	110	392

The total registration in the Summer School was 258 students as compared with 214 in 1902; the registration in the various subjects is shown in the following table:—

	1903
Mathematics.	
Analytic Geometry	21
Integral Calculus	33
Applied Mechanics	45
Mechanical Drawing and Descriptive Geometry . . .	52
Mechanic Arts (Shopwork).	
Forging	13
Chipping and Filing	7
Machine-Tool Work	14
Modern Languages.	
French	33
German	17
Chemistry.	
Inorganic and Analytical Chemistry	60
Air, Water, and Food Analysis	12
Physics.	
Mechanics, Light, and Electricity	59
Heat	11
Physical Laboratory	15
Civil Engineering.	
Surveying	20
Mechanical Engineering.	
Mechanism	23
Mechanical Engineering Drawing	6

RESIDENCE OF STUDENTS.

States.	Candidates for Advanced Degrees.	Fourth Year.	Third Year.	Second Year.	First Year.	All Regular Students.	Special Students.	Total.
Alabama	–	1	–	–	–	1	–	1
Arkansas	–	–	–	–	–	–	1	1
California	–	4	–	4	4	12	7	19
Colorado	–	–	1	5	2	8	3	11
Connecticut	–	10	6	5	5	26	18	44
Delaware	–	–	2	–	–	2	1	3
Dist. of Columbia,	–	6	2	4	1	13	2	15
Florida	–	–	–	–	–	–	2	2
Georgia	–	–	–	1	–	1	3	4
Hawaii	–	–	–	–	–	–	1	1
Illinois	–	10	7	7	3	27	17	44
Indiana	1	2	1	2	–	6	–	6
Iowa	–	1	1	–	1	3	3	6
Kansas	–	–	–	–	1	1	–	1
Kentucky	–	–	4	1	–	5	4	9
Louisiana	–	–	–	1	–	1	1	2
Maine	–	2	8	6	2	18	16	34
Maryland	–	6	4	5	2	17	8	25
Massachusetts	12	138	130	179	180	639	230	869
Michigan	–	1	1	2	1	5	4	9
Minnesota	–	1	–	2	1	4	5	9
Mississippi	–	–	–	–	3	3	1	4
Missouri	–	3	5	4	2	14	8	22
Montana	–	1	–	–	–	1	1	2
Nebraska	–	1	1	–	–	2	2	4
New Hampshire	–	4	5	6	4	19	4	23
New Jersey	–	1	1	4	2	8	5	13
New Mexico	–	–	–	–	–	–	1	1
New York	–	13	23	11	13	60	44	104
North Carolina	1	1	2	–	1	5	2	7
North Dakota	–	–	–	–	1	1	–	1
Ohio	–	8	6	4	5	23	14	37
Oregon	–	1	1	2	–	4	3	7
Pennsylvania	–	3	3	10	14	30	22	52
Porto Rico	–	–	1	1	–	2	–	2
Rhode Island	–	8	4	6	1	19	9	28
South Dakota	–	1	1	1	–	3	–	3
Tennessee	1	1	–	–	–	2	3	5
Texas	–	2	1	1	2	6	5	11
Utah	–	–	1	–	–	1	2	3
Vermont	–	3	1	3	–	7	4	11
Virginia	1	1	–	2	–	4	3	7
Washington	–	1	–	–	–	1	2	3
Wisconsin	1	1	4	4	1	11	2	13
Foreign Countries.								
Armenia	–	–	–	–	–	–	1	1
Australia	–	–	–	2	–	2	1	3
Bermuda	–	–	–	–	–	–	1	1
Brazil	–	–	–	1	–	1	2	3
Chili	–	–	–	–	–	–	1	1
China	–	–	1	–	–	1	1	2
Cuba	–	–	–	1	1	2	1	3
Denmark	–	–	–	–	–	–	1	1
England	–	–	2	1	–	3	1	4
Germany	–	1	–	–	–	1	1	2
India	–	–	–	–	–	–	1	1
Ireland	–	–	–	–	–	–	1	1
Japan	–	–	–	–	–	–	2	2
Malta, Island of	–	–	–	–	1	1	–	1
Manitoba	–	–	1	–	–	1	–	1
Mexico	–	–	1	–	–	1	7	8
New Brunswick	–	–	–	–	–	–	1	1
Nova Scotia	1	1	3	1	1	7	2	9
Ontario	–	–	2	–	–	2	–	2
Quebec	–	–	–	–	–	–	1	1
Scotland	–	–	–	–	–	–	1	1
Syria	–	–	1	–	–	1	–	1
Total	18	238	238	289	255	1,038	490	1,528

Forty states of the Union and two territories, besides the District of Columbia and Porto Rico, are represented on our list of students. Of the total number of 1,528, 869 are from Massachusetts, or 57 per cent. of the whole; 140 are from other New England states; 519 are from outside New England. Of these, 50 are from foreign countries.

A table showing the number of students in each year, from 1897, coming from each state or territory, and from each foreign country, may be not without interest and instruction: —

States.	1897.	1898.	1899.	1900.	1901.	1902.	1903.
Alabama	1	1	–	1	2	1	1
Arkansas	1	–	–	1	1	1	1
California	9	11	9	10	9	15	19
Colorado	8	8	7	8	6	10	11
Connecticut	30	26	29	35	42	43	44
Delaware	6	3	4	4	3	4	3
Dist. of Columbia	13	8	7	13	14	17	15
Florida	1	–	1	1	1	2	2
Georgia	4	4	3	3	4	6	4
Hawaiian Islands	–	1	–	1	–	–	1
Idaho	1	–	–	–	1	–	–
Illinois	40	51	36	39	44	49	44
Indiana	7	3	5	7	11	14	6
Iowa	12	7	6	10	8	8	6
Kansas	3	–	–	–	1	1	1
Kentucky	10	10	4	5	9	11	9
Louisiana	1	1	1	2	1	2	2
Maine	24	19	25	22	30	35	34
Maryland	8	8	8	13	16	27	25
Massachusetts	739	719	731	770	837	935	869
Michigan	5	9	10	8	12	10	9
Minnesota	8	11	10	7	10	10	9
Mississippi	–	–	–	–	–	–	4
Missouri	6	10	11	13	19	20	22
Montana	5	2	3	5	4	3	2
Nebraska	2	1	3	4	3	5	4
Nevada	–	–	1	1	–	–	–
New Hampshire	25	25	29	26	31	34	23
New Jersey	15	13	12	8	6	8	13
New Mexico	–	–	–	–	–	1	1
New York	62	68	61	68	79	96	104
North Carolina	1	2	2	2	6	6	7
North Dakota	–	–	–	–	–	1	1
Ohio	30	23	27	27	27	43	37
Oregon	3	3	2	1	2	4	7
Pennsylvania	41	34	33	37	36	44	52
Porto Rico	–	–	–	–	1	2	2
Rhode Island	19	23	32	35	38	40	28
South Carolina	4	1	1	1	2	4	–
South Dakota	–	–	1	1	2	1	3
Tennessee	3	3	4	6	4	3	5
Texas	2	1	2	4	7	9	11
Utah	3	5	6	7	7	2	3
Vermont	11	12	12	15	15	12	11
Virginia	4	3	2	3	5	7	7
Washington	4	7	4	2	4	3	3
West Virginia	1	–	1	1	1	–	–
Wisconsin	6	8	7	8	11	11	13
Wyoming	–	–	–	–	–	1	–
Foreign Countries.							
Armenia	–	–	–	–	–	–	1
Australia	–	–	–	–	–	2	3
Austria	–	–	–	–	1	–	–
Bermuda	–	–	–	1	2	1	1
Brazil	–	–	–	–	4	5	3
Cape Breton	–	1	–	–	–	–	–
Chili	–	–	–	–	1	1	1
China	–	–	–	–	1	1	2
Cuba	1	1	–	–	1	2	3
Denmark	2	1	1	1	1	1	1
Dutch Guiana	–	1	1	–	–	–	–
England	2	4	1	3	3	3	4
France	1	1	2	4	1	–	–
Germany	–	1	1	2	3	1	2
India	–	–	–	–	–	–	1
Ireland	–	–	–	–	–	1	1
Jamaica	–	–	1	1	1	–	–
Japan	–	1	2	2	2	1	2
Malta, Island of	–	–	–	–	–	–	1
Manitoba	–	–	–	–	–	1	1
Mexico	6	7	7	7	7	10	8
New Brunswick	2	3	3	2	2	2	1
Nova Scotia	1	2	–	2	6	8	9
Ontario	–	–	–	–	3	2	2
Quebec	2	1	3	4	2	–	1
Russia	–	–	1	1	1	–	–
Scotland	–	–	–	–	–	1	1
Syria	–	–	–	–	–	–	1
Turkey	3	3	3	3	1	4	–
Total	1,198	1,171	1,178	1,277	1,415	1,608	1,528

RESIDENCE OF MASSACHUSETTS STUDENTS.

It has been said that 57 per cent. of our students are from Massachusetts. All the counties of the State send students to the Institute. One hundred and forty-one cities and towns

are on the lists. The first column of the following table shows the number of cities and towns in each county sending pupils: the second column gives the aggregate number from each county. It appears that Middlesex sends two hundred and seventy-five and Suffolk two hundred and forty-two pupils; Essex comes third, with one hundred and twenty-two; Norfolk, fourth, with eighty-one.

County.	No. of Towns.	No. of Students.	County.	No. of Towns.	No. of Students.
Barnstable	3	6	Hampshire	2	6
Berkshire	5	14	Middlesex	37	275
Bristol	12	32	Nantucket	1	2
Dukes	1	1	Norfolk	18	81
Essex	23	122	Plymouth	13	28
Franklin	4	7	Suffolk	4	242
Hampden	4	17	Worcester	14	36
			Total	141	869

The following is a list of the towns, forty-five in number, which send five or more students to the Institute: —

Boston	227	Fitchburg	10	Arlington	6
Newton	49	Haverhill	10	Beverly	6
Malden	22	Medford	10	Canton	6
Somerville	21	New Bedford	10	Everett	6
Cambridge	20	Quincy	9	Natick	6
Brookline	19	Springfield	9	Peabody	6
Lowell	19	Gloucester	8	Weymouth	6
Waltham	19	Taunton	8	Winthrop	6
Newburyport	17	Wakefield	8	Woburn	6
Salem	17	Andover	7	Concord	5
Lawrence	16	Belmont	7	Hanover	5
Framingham	15	Brockton	7	Holyoke	5
Lynn	14	Chelsea	7	Marlboro	5
Hyde Park	13	Stoneham	7	Milford	5
Melrose	11	Winchester	7	North Adams	5

The following table exhibits for ten years the distribution of the total number of students among two classes: first, those students whose names are found upon the Catalogue of the year preceding; and, secondly, those whose names appear first upon the Catalogue of the year to which the statement relates.

Year.	(1) Total No. of Students.	(2) No. of Students in the catalogue of the previous year who remain in the Institute.	(3) No. of New Students entering before issue of catalogue.	(4) Of those in column (3) the following number are regular First-year Students.	(5) No. of New Students not of the regular First - year Class.
1893–94	1,157	701	456	301	155
1894–95	1,183	768	415	271	144
1895–96	1,187	778	409	266	143
1896–97	1,198	758	440	263	177
1897–98	1,198	757	441	277	164
1898–99	1,171	769	402	278	124
1899–1900	1,178	764	414	275	139
1900–1901	1,277	789	488	312	176
1901–1902	1,415	844	571	396	175
1902–1903	1,608	949	659	432	226
1903–1904	1,528	1,042	486	249	237

AGES OF STUDENTS.

The next table exhibits the ages of our students upon entrance, after taking out six who are repeating the first year, and five persons of unusual ages. These deductions leave two hundred and forty-five as the number of students whose ages have been made the subject of computation.

Period of Life.	1902–1903.		1903–1904	
	Half-year Groups.	Yearly Groups.	Half-year Groups.	Yearly Groups.
16 to 16½ years	3	—	1	—
16½ to 17 "	12	15	9	10
17 to 17½ "	30	—	13	—
17½ to 18 "	49	79	38	51
18 to 18½ "	85	—	50	—
18½ to 19 "	65	150	38	88
19 to 19½ "	65	—	31	—
19½ to 20 "	47	112	34	65
20 to 20½ "	28	—	14	—
20½ to 21 "	10	38	8	22
21 to 22 "	23	23	9	9
	417	417	245	245

The results appear in the table above in comparison with the corresponding results of 1902–1903.

From the foregoing it appears that the average age on entrance is eighteen years and ten months.

In this connection are presented the ages, at graduation, of the class which left us in June. The one hundred and ninety members of the class were distributed among the different periods of life as follows: —

Under 20½	1
Between 20½ and 21	4
" 21 " 21½	19
" 21½ " 22	19
" 22 " 23	48
" 23 " 24	39
" 24 and over	60
Total	190

The special students this year constitute thirty-two per cent. of the whole body, as against twenty-eight per cent. last year and twenty-nine per cent. the year before.

GRADUATE STUDENTS.

The number of students who are graduates of this and other institutions is one hundred and seventy-three. Of these eighteen are candidates for advanced degrees, thirteen being our own graduates.

One hundred and fifty-five are graduates of the following institutions, and are pursuing undergraduate courses of study with us either as regular or as special students.

Universities.

Acadia	3	Norwich	1
Boston	2	Ohio State	1
Brown	1	Pennsylvania State	5
California	1	Porto Rico	1
Chicago	2	Princeton	9
Colgate	1	Rochester	3
Columbia	1	St. Louis	2
Cornell	1	Southwestern	1
Georgetown	3	Southwestern Presbyterian	1
Hamline	1	Tennessee	1
Harvard	20	Texas	1
Indiana	1	Tulane	1
Johns Hopkins	4	Virginia	2
Louisiana	1	Washington	1
Maine	1	Washington and Lee	1
Mercer	1	Wesleyan	1
Miami	1	Yale	7
Northwestern	1		85

Colleges.

Adelbert	1	Oberlin	3
Amherst	5	Ouachita	1
Bates	1	Pomona	1
Beloit	2	Randolph-Macon	1
Bowdoin	2	Rock Hill	2
Butler	1	Saint Ignatius	2
Canisius	1	Saint Joseph	2
Central	1	Saint Xavier	1
Colby	3	Sheffield Scientific School	5
Colorado	1	Syrian Protestant	1
Connecticut Agricultural	1	Texas Agricultural and Mechanical	1
Davidson	1	Trinity	2
Delaware	1	Tufts	2
Detroit	1	United States Naval Academy	12
Earlham	1	Virginia Medical	1
Hamilton	1	Wellesley	1
Haverford	1	Westminster	1
Holy Cross	1	Williams	1
Iowa	2	Wittenberg	1
Massachusetts Institute of Technology	15	Yankton	1
Middlebury	1		92
Mount Allison	1		
München Technische Hochschule	1	Total	174
New Hampshire College of Agriculture	1	Deduct names counted twice	4
City of New York	2		173
North Texas Normal	1		

WOMEN STUDENTS.

The number of women pursuing courses with us is twenty-six. Of these three are graduates of colleges. Of the total number six are regular students of the fourth year, five of the first year. Thirteen are special students. Of the eleven regular students of the upper classes, four take Course IV., Architecture; five Course V., Chemistry; one, Course VII., Biology; and one, Course XII., Geology. Of the special students, four devote themselves to architecture, four to biology, one to chemistry, one to physics, and one to general studies, while two are first-year specials.

STATISTICS OF ADMISSION.

Of the 1,528 students of the present year, 486 were not connected with the school in 1902–1903. Of these 237 were admitted as regular students of the first year upon the basis of their entrance examinations. The 249 remaining comprise (1) those who had previously been connected with the Institute, and have resumed their places in the school; (2) those who were admitted provisionally without examinations; (3)

those who were admitted by examination as regular second-year or as special students; (4) those who were admitted on the presentation of diplomas or certificates from other institutions of college grade or from the College Examination Board. In addition to the 237 who were thus admitted to the first year on examination, and have taken their place in the school, 77 were admitted on examination, but have not entered the school.

In the case of the 237 persons who were admitted on examination, and have joined the school, the results of the examinations, embracing both those of June and those of September, were as follows: —

Admitted	clear	179
"	on one condition	41
"	on two conditions	13
"	on three conditions	4
		237

Ninety-four applicants were rejected.

GRADUATES BY COURSES.

The following table exhibits the number of persons who have received the Bachelor's Degree in each of the several courses since the foundation of the school: —

Year.	Civil Engineering.	Mechanical Engineering.	Mining Engineering.	Architecture.	Chemistry.	Metallurgy.	Electrical Engineering.	Natural History or Biology.	Physics.	General Course.	Chemical Engineering.	Sanitary Engineering.	Geology.	Naval Architecture.	Total.
1868	6	1	6	–	–	–	–	–	–	1	–	–	–	–	14
1869	2	2	–	–	1	–	–	–	–	–	–	–	–	–	5
1870	4	2	2	–	1	–	–	–	–	1	–	–	–	–	10
1871	8	2	5	–	2	–	–	–	–	–	–	–	–	–	17
1872	3	1	5	–	3	–	–	–	–	–	–	–	–	–	12
1873	12	2	3	1	7	–	–	–	–	1	–	–	–	–	26
1874	10	4	1	1	–	–	–	–	–	2	–	–	–	–	18
1875	10	7	6	1	1	–	–	–	1	2	–	–	–	–	28
1876	12	8	7	–	5	1	–	2	3	4	–	–	–	–	42
1877	12	6	8	4	2	–	–	–	–	–	–	–	–	–	32
1878	8	2	2	3	3	–	–	–	–	1	–	–	–	–	19
1879	6	8	3	1	3	–	–	1	1	–	–	–	–	–	23
1880	3	–	3	–	1	–	–	–	–	1	–	–	–	–	8
1881	3	5	6	3	8	–	–	1	–	2	–	–	–	–	28
1882	2	5	5	3	6	–	–	1	1	1	–	–	–	–	24
1883	3	7	5	1	3	–	–	–	–	–	–	–	–	–	19
1884	5	6	13	–	12	–	–	–	–	–	–	–	–	–	36
1885	4	7	8	2	4	–	2	–	–	1	–	–	–	–	28
1886	9	23	7	1	7	–	10	1	–	1	–	–	–	–	59
1887	10	17	8	1	9	–	8	1	1	3	–	–	–	–	58
1888	11	25	4	5	10	–	17	3	1	1	–	–	–	–	77
1889	14	24	5	3	8	–	17	1	1	2	–	–	–	–	75
1890	25	28	3	5	13	–	18	3	2	6	–	–	–	–	103
1891	18	26	4	6	11	–	23	3	3	1	7	–	1	–	103
1892	22	26	4	13	7	–	36	6	1	7	4	6	1	–	133
1893	25	30	5	2	8	–	41	2	–	6	8	–	2	–	129
1894	21	31	4	14	11	–	33	1	3	5	12	3	–	–	138
1895	25	30	3	15	14	–	33	–	2	4	11	4	–	5	144*
1896	26	34	10	24	17	–	48	3	3	7	7	4	3	5	190*
1897	25	40	7	16	20	–	33	2	3	7	12	4	1	9	179
1898	32	41	7	29	25	–	33	3	4	6	9	3	–	7	199
1899	30	37	9	22	22	–	32	2	2	1	10	1	–	8	173*
1900	32	34	21	21	19	–	23	3	3	5	11	4	–	9	185
1901	37	39	18	21	17	–	25	1	1	6	14	4	1	16	200
1902	24	46	14	18	14	–	35	5	3	3	9	7	–	14	192
1903	26	37	27	15	13	–	39	1	4	1	10	4	1	12	190
Totals	525	643	248	251	307	1	506	46	43	89	124	44	10	85	2,916*
Deduct names counted twice															16
Net total															2,900*

* Deducting names counted twice.

PART V.

GENERAL STATEMENT

OF THE

RECEIPTS AND DISBURSEMENTS BY THE TREASURER

FOR THE YEAR ENDING SEPT. 30, 1903

STATEMENT OF THE TREASURER.

The Treasurer submits the annual statement of the financial affairs of the Institute for the year ending September 30, 1903.

The net result of the year is a deficit of $36,432.14 in income compared with current expenses, and this, too, in spite of an increase in students' fees amounting to about $33,000. This is the largest deficit in the history of the Institute, and yet there was never a time when the number of students was so large, or the vigor and success of the different departments in the matter of education, so great.

Going back to the year 1891 we find the number of students was then 937; this last year it has been 1,608.

If the present deficit were considered by itself it might be accounted for in part by an increased expenditure for coal due to the exceptional conditions of last year, and amounting to about $15,000, and in part by expenditures indirectly growing out of the rapid growth of the Institute, which has necessitated the construction of new buildings and a large increase in equipment. The expenditure for the new buildings themselves, and for new machinery to equip them, is not included in the above figures. But if we go back to 1891 and follow the figures from that time to the present date, we find that the increase in expenses has been greater proportionally than the increase in students, and that this has gone on year by year, and that such increase is not limited to any one item but embraces all the principal ones. The underlying cause seems to be that with the progress in technical education in all high grade technical schools more and more is required of any educational institution which aims to hold a foremost rank. There was never a time in the history of the Institute when the facilities were so good or when so much was offered to its students as at the present time.

The total property of the Institute amounts to a little more than $3,600,000, not including the land on Boylston Street. Of this real estate and equipment represent just about one-half. Of the $1,800,000 in round numbers, which is invested in interest bearing securities, something over $800,000 is held for scholarships or similar purposes, leaving only about $1,000,000 of personal property from which income is derived for current expenses. To this should be added the rents, amounting to about $10,000, received from a small portion of the real estate, and making a total available income of about $50,000. It is manifest, therefore, that the income from endowment is insignificant as compared with annual expenses, which this year amount to about $468,000 apart from those paid from funds for scholarships and the like. The main support of the Institute is derived from students' fees. Anyone familiar with educational institutions of the first rank, knows that it is practically impossible to support them simply on the revenue derived from students' fees. This difficulty is especially great in the case of technical education where the proportion of instructors to students must be large, and where new and expensive apparatus is constantly required. It should be borne in mind that our tuition fee has been raised above that of any similar educational institution in the world and cannot be further advanced. The grant from the State of $25,000 per annum for ten years cannot be relied on as permanent. The recent action of the legislature in giving to the Institute the fee of the land on Boylston Street makes possible further growth either by using more of that land, or by selling what land we now own and removing to some less expensive site, but in either case large additional endowment is necessary. If we remain where we are we must have money for new buildings, and even then our present limits will be outgrown before many years are past. If we move, the proceeds of the land

sold will not suffice to purchase new land, erect new buildings, pay expenses of removal, and provide any satisfactory endowment for carrying on the work. The problem which confronts us is not one appealing only to friends of the Institute, or to local pride. It is freely acknowledged both in this country and in Europe that the work done by the Massachusetts Institute of Technology in technical education has been of the highest value to all, and its continued success should be a matter of interest to all who believe in the importance of higher technical training. It is, however, manifest that to provide adequately for the future a large additional endowment must be secured, and this is a subject demanding most careful consideration from all friends of the Institute.

During the year there has been expended for the Augustus Lowell Laboratory of Electrical Engineering, $52,036.83, and for equipment for the same, $66,695.60. There has also been spent for the new engineering building, $38,059.13.

The following legacies and gifts have been received: —

Additional payments from the estate of the late Henry L. Pierce, $45,000.

Additional subscriptions to the Walker Memorial Fund, $10,050.

For the Augustus Lowell Laboratory of Electrical Engineering additional subscriptions as follows: —

Mrs. William L. Putnam, $10,000; Mrs. T. J. Bowlker, $10,000; Miss Amy Lowell, $10,000; C. C. Jackson, Esq., $3,000; A Friend, $3,000; in all, $36,000.

From the Estate of Joseph B. Glover, $5,000.

From the estate of James H. Danforth to establish the Isaac Warren Danforth Scholarship Fund, $5,000.

For the Sewage Experimental Fund. an additional $5,000 has been paid by the same generous giver who contributed the like amount a year ago.

For the Chemical Research Fund, Prof. A. A. Noyes has contributed $3,000, and Prof. W. R. Whitney, $1,000. $1,000 for the same purpose have also been received from the trustees of the estate of William E. Hale.

$6,000 have been contributed to the Dormitory Fund as follows: Mrs. Edward M. Cary, $3,000; Estate of Mrs. Mary Hemenway, $1,000; Mrs. Henry Pickering, $1,000; A Friend, $1,000.

From the estate of the late Susan E. Dorr an additional gift of $1,940.38.

Besides the above, $895.75 have been contributed for various purposes, including $500 from a friend to be used in payment of salaries, $200 from Mrs. Wm. B. Rogers for the purchase of periodicals, and $150 from Col. Thomas L. Livermore.

The total net increase in the property of the Institute of all kinds held for either general or special purposes, apart from money borrowed, is $49,427.20.

The total amount paid in for the Walker Memorial Fund during the past year has been $10,050. Adding this to the sum previously in the fund, and deducting $1,025 and $307.10 for architects' fees and plans, make the fund $80,065.20, to which are to be added as interest $3,401.50, making a total of $83,466.70.

Securities Sold or Paid, General Account.

$1,000 Bur. & Missouri River R.R. 6s	1918	1,000.00
6,000 West End Street Rwy. 5s	1902	6,000.00
47,000 Walter Baker Co. Ltd. 4½s	1903	47,000.00
4,000 Ozark Equipment Co. 5s	1910	4,000.00
25 Shares National Bank of the Republic		4,320.00
40 " The Molson's Bank, Montreal		4,025.00
		$66,345.00

GEORGE WIGGLESWORTH, TREASURER, *in account with*
GENERAL STATEMENT OF RECEIPTS AND DISBURSEMENTS

Dr.

Cash balance, Sept. 30, 1902		18,307.26
From A. Lawrence Lowell for Lowell Institute Courses		6,105.70
RECEIPTS FOR CURRENT EXPENSES.		
Income of funds for salaries	4,324.00	
" " " " Savage Fellowship	400.00	
" " " " scholarships (students' fees),	11,425.00	
" " " " Joy "	275.00	
" " " " W. B. Rogers Scholarships,	525.00	
" " " " Library	480.00	
" " " " general purposes	26,710.42	
" " Rogers Memorial Fund	10,970.50	
" " Charlotte B. Richardson Fund	1,495.15	
" " Rotch Prize Funds	400.00	
" " Rotch Architectural Fund	1,000.00	
" " Edward Austin Fund, Scholarships	7,350.00	
" " " " " Awards	2,474.72	
" " Teachers' Fund	500.00	
Letter Box Fund	75.00	
Students' fees	286,660.55	
State Scholarships	4,000.00	
United States Act of 1862	5,223.94	
United States Act of 1890	8,333.34	
Gift of State of Massachusetts	25,000.00	
Laboratory supplies and breakages	16,080.40	
Rents, per Table (page 12)	10,065.03	
Gifts	895.75	
Interest	5.153.38	
Boston University	2,898.00	
Sale Printed Lecture Notes	4,093.27	436,808.45
GIFTS AND BEQUESTS FOR SPECIAL PURPOSES.		
Increase Scholarship Funds	378.18	
" Teachers' Fund	3,500.00	
" Edward Austin Fund	4,575.28	
" Susan E. Dorr Fund, additional	1,940.38	
Aug. Lowell Lab. Electrical Eng. Fund, add'l,	36,000.00	
Isaac W. Danforth Fund	5,000.00	51,393.84
GIFTS AND BEQUESTS FOR GENERAL PURPOSES.		
Henry L. Pierce Legacy, additional	45,000.00	
Joseph B. Glover Legacy	5,000.00	50,000.00
SECURITIES SOLD OR PAID.		
General Fund, page 3		66,345.00
SUNDRIES.		
Income credited to Bond Premium Acc't	3,635.00	
" " " Rogers Bond Premium Acc't,	832.50	
Copley Society of Boston, on acc't	666.66	
Walker Memorial Fund, additional	13,451.50	
Sewage Experiment Fund, additional	5,000.00	
Dormitory Fund	6,000.00	
Chemical Research Fund	5,000.00	
Notes Payable	25,000.00	59,585.66
		$688,545.91

MASSACHUSETTS INSTITUTE OF TECHNOLOGY.
FOR THE YEAR ENDING SEPT. 30, 1903.

Cr.

Paid for Lowell Institute Courses		6,105.70

EXPENSES.

Salaries, per Table (page 12)	319,573.58	
" paid from Gifts	500.00	
Fellowship paid from Savage Fund	400.00	
" " " Dalton Grad. Chem. Fund,	250.00	
" " " Willard B. Perkins "	1,000.00	
Edward Austin Fund, Awards	2,474.72	
Teachers' Fund "	500.00	
Prizes, Rotch Funds	400.00	
Repairs, per Table (page 13)	15,986.58	
General Expenses, per Table (page 13)	30,398.98	
Fire Insurance	4,153.68	
Fuel	25,131.68	
Water	3,246.00	
Gas	2,704.08	
Electricity	1,689.74	
Printing and Advertising	7,548.44	
" Lecture Notes	2,729.48	
" Annual Catalogues and Reports	3,854.01	
Rents paid Natural History Society	200.00	
" " 71 Newbury Street	266.70	
Laboratory Supplies and Libraries, per Table (p. 12),	49,978.10	
Society of Arts	169.82	
Pan-American Exposition	85.00	473,240.59

(Expenses more than Income, $36,432.14)

SECURITIES BOUGHT OR RECEIVED AS LEGACIES.

Walker Memorial Fund		39,000.00

SUNDRIES.

Extension Lot, No. 3 Trinity Place	26.35	
Aug. Lowell Lab. Electrical Eng. Bldg., 1902	52,036.83	
Brookline Real Estate	60.00	
Walker Memorial Fund, expense	307.10	
Equipment Electrical Engineering Building	66,695.60	
Engineering Building C	38,059.13	
Sewage Fund, expended	5,492.60	
Chemical Research Fund, expended	109.00	
Dormitory Fund, expended	1,667.30	
Students' Deposits	200.00	164,653.91
Cash balance Sept. 30, 1903		5,545.71
		$688,545.91

The following account exhibits the property held by the Institute, as per Treasurer's books, Sept. 30, 1903: —

INVESTMENT OF THE W. B. ROGERS MEMORIAL FUND.

30,000.00	Burlington & Mo. River R.R. 4s	1910	25,787.50
27,000.00	Kansas City Belt R.R. 6s	1916	27,000.00
6,000.00	New York & New England R.R. 6s,	1905	6,000.00
3,800.00	Republican Valley R.R. 6s	1919	3,800.00
4,000.00	Cin., Ind., St. Louis & Chicago R.R. 6s,	1920	4,000.00
4,000.00	Kansas City, Fort Scott & Gulf R.R. 7s,	1908	4,000.00
1,000.00	Lincoln & Northwestern R.R. 7s	1910	1,000.00
1,000.00	Atchison & Nebraska R.R. 7s	1908	1,000.00
35,000.00	Fort Street Union Depot 4½s	1941	34,825.00
24,000.00	Rome, Watertown & Ogdensburg R.R. 5s	1922	24,000.00
37,500.00	Detroit, G. Rapids & Western R.R. 4s,	1946	37,500.00
25,000.00	Atchison, Top. & St. Fé R.R. 4s	1995	24,470.00
7,000.00	Chesapeake & Ohio R.R. 5s	1939	7,000.00
38,000.00	Chi. Junc. & Union Stock Yards 5s	1915	38,000.00
3,000.00	Chi., Mil. & St. Paul R.R. 7s	1905	3,000.00
	Advances to Bond Premium acc't		8,375.00
			249,757.50

INVESTMENTS, GENERAL ACCOUNT.

7,000.00	Bur. & Mo. River (Neb.) R.R. 6s, non-exempt	1918	7,000.00
2,000.00	Bur. & Mo. River (Neb.) R.R. 6s, exempt	1918	2,000.00
5,000.00	Chicago, Burlington & Quincy R.R 4s	1922	4,100.00
3,000.00	Hannibal & St. Joseph R.R. 6s	1911	3,000.00
35,000.00	Fitchburg R.R. 5s	1903	35,000.00
65,000.00	Boston & Maine R.R. 4½s	1944	65,000.00
26,000.00	Am. Dock & Improvement Co. 5s	1921	26,000.00
3,000.00	Illinois Central R.R. 4s	1951	3,000.00
26,000.00	New York & New England R.R. 6s	1905	26,000.00
8,000.00	Chi. Junc. & Union S. Yards 5s	1915	8,000.00
5,000.00	Dominion Coal Co. 1st. 6s	1913	5,000.00
2,000.00	New England Tel. & Tel. Co. 6s	1907	2,000.00
2,000.00	New York & New England R.R. 7s,	1905	2,000.00
100,000.00	West End Street Ry. 4s	1917	100,000.00
50,000.00	Utah & Northern R.R. 1st 7s	1908	50,000.00
50,000.00	Chi. Terminal & Transfer Co. 1st 4s,	1947	47,507.50
120,000.00	Illinois Steel Co., non-conv. 5s	1913	119,586.25
43,000.00	Chesapeake & Ohio R.R. 5s	1939	43,000.00
100,000.00	Long Island R.R. 4s	1949	96,137.50
7,000.00	K. C., Clinton & Springfield R.R. 5s,	1925	6,289.21
8,500.00	K. C., Mem. & Birmingham R.R. 4s,	1934	8,287.50
13,000.00	K. C., St. Jo. & Council Bluffs R.R. 7s	1907	13,000.00
50,000.00	Kansas City Stock Yards 5s	1910	50,000.00
25,000.00	Atchison, Top. & St. Fé R.R. 4s	1995	25,000.00
50,000.00	Rio Grande & Western R.R. 4s	1939	49,180.00
50,000.00	Oregon R.R. & Navigation Co. 4s,	1946	50,000.00
50,000.00	Union Pacific R.R. 4s	1947	50,000.00
100,000.00	Chic. & W. Michigan R.R. 5s	1921	100,000.00
100,000.00	American Tel. & Tel. Co. 4s	1929	99,875.00
50,000.00	New England Tel. & Tel. Co. 4s	1930	50,000.00
50,000.00	Chi. Junc. & Union S. Yards 4s	1940	49,250.00
50,000.00	K. C., Fort Scott & Memphis R.R. 6s	1928	50,000.00
25,000.00	Southern Ry., St. Louis Div. 4s	1951	24,875.00
18,000.00	Ozark Equipment Co. 5s	1910	18,000.00
50,000.00	Northern Pac. Gt. Northern Joint 4s,	1921	48,500.00
	Advances to Bond Premium acc't		36,575.00
			1,373,162.96
	Amount carried up		$1,622,920.46

	Amount brought up				$1,622,920.46
	STOCKS.				
Shares.					
172	Boston & Albany R.R.	par	100	34,456.50	
50	Chi., Milwaukee & St. Paul R.R. Pf.	"	100	6,775.00	
12	Cocheco Manufacturing Co.	"	500	6,000.00	
56	Hamilton Woolen Co.	"	100	5,390.00	
31	Great Falls Manufacturing Co.	"	100	3,472.00	
2	Dwight Manufacturing Co.	"	500	1,600.00	
17	Pepperell Manufacturing Co.	"	100	2,789.50	
27	Essex Co.	"	50	3,780.00	
64	Boston Real Estate Trust	"	1000	68,909.64	
1	Boston Ground Rent Trust	"	1000	900.00	134,072.64
	INVESTMENT OF THE JOY SCHOLARSHIP FUND.				
	Massachusetts Hospital Life Insurance Co. .			5,000.00	
	Deposits in Savings Banks			4,123.70	9,123.70
	INVESTMENT SWETT SCHOLARSHIP FUND.				
	Massachusetts Hospital Life Insurance Co.				10,000.00
	Amount carried up				$1,776,116.80

Amount brought up			$1,776,116.80
REAL ESTATE.			
Rogers Building		200,000.00	
Walker "		150,000.00	
Land on Garrison Street	50,840.00		
Mechanic Arts Building	30,000.00	80,840.00	
Land on Trinity Place	76,315.69		
Engineering Bldg, A, Trinity Place .	90,000.00	166,315.69	
Gymnasium Building		7,967.85	
Engineering Building, B		57,857.10	
Engineering Building, C		38,059.13	
Lot No. 2, Trinity Place		137,241.60	
Lot No. 3, " "		282,286.35	
Henry L. Pierce Building, Trinity Place . . .		154,297.05	
Boiler and Power House, " " . . .		26,916.74	
Clarendon St. Land and Building		142,762.94	
Real Estate, Massachusetts Ave., Cambridge .		16,154.38	
Real Estate, Brookline, Mass.		112,964.32	
Aug. Lowell Lab. Elec. Eng. Bldg., 1902 . . .		121,741.95	1,695,405.10
Equipment, Engineering Building		16,555.24	
" Mechanical Laboratories		20,628.56	
" Elec. Eng. Building		66,695.60	103,879.40
SUNDRIES.			
Notes Receivable		37,000.00	
Loans to Copley Society of Boston		8,333.33	
Students' Notes		770.50	
Cash Balance, Sept. 30, 1903		5,545.71	51,649.54
			$3,627,050.84

The foregoing property represents the following Funds and Balances, and is answerable for the same.

The income of the following is used for the general purposes of the Institute: —

William Barton Rogers Memorial Fund . . .	250,225.00	
Richard Perkins Fund	50,000.00	
George Bucknam Dorr Fund	49,573.47	
Martha Ann Edwards "	30,000.00	
Nathaniel C. Nash "	10,000.00	
Sidney Bartlett "	10,000.00	
Robert E. Rogers "	7,680.77	
Albion K. P. Welch "	5,000.00	
Stanton Blake "	5,000.00	
McGregor "	2,500.00	
Katharine B. Lowell "	5,000.00	
Samuel E. Sawyer "	4,764.40	
John W. and Belinda Randall Fund	83,452.36	
James Fund	163,654.21	
George Robert Armstrong Fund	5,000.00	
Arthur T. Lyman Fund	5,000.00	686,850.21
Amount carried up		$686,850.21

Amount brought up		$686,850.21
The income of the following is used towards paying salaries: —		
Nathaniel Thayer, for Professorship of Physics .	25,000.00	
Jas. Hayward, for Professorship of Engineering	18,800.00	
William P. Mason, " " Geology . .	18,800.00	
Henry B. Rogers, for general salaries	25,000.00	
George A. Gardner, " "	20,000.00	
Sarah H. Forbes, "	500.00	108,100.00
SCHOLARSHIP TRUSTS.		
Richard Perkins Fund	53,298.45	
James Savage "	14,303.38	
Susan H. Swett "	10,582.95	
William Barton Rogers Fund	10,721.61	
Joy Fund	9,048.70	
Elisha Thatcher Loring Fund	5,370.52	
Charles Lewis Flint "	5,285.63	
Thomas Sherwin "	5,000.00	
Farnsworth "	5,000.00	
James H. Mirrlees "	2,841.43	
William F. Huntington "	5,234.33	
T. Sterry Hunt "	3,233.50	
Elisha Atkins "	5,000.00	
Nichols "	5,000.00	
Ann White Vose "	60,809.28	
Ann White Dickinson "	40,668.64	
Dalton Grad. Chemical "	6,480.30	
Willard B. Perkins "	6,397.26	
Billings Student "	50,000.00	
Henry Saltonstall "	10,000.00	
Isaac W. Danforth "	5,000.00	319,275.98
OTHER TRUSTS.		
Charlotte Billings Richardson Ind. Chem. Fund,		37,378.78
Susan Upham Fund		1,301.52
Susan E. Dorr "		14,897.01
William Hall Kerr Library Fund		2,000.00
Charles Lewis Flint " "		5,000.00
Rotch Architectural " "		5,000.00
Rotch Architectural Fund		25,000.00
Rotch Prize "		5,200.00
Rotch "Special" Prize Fund		5,200.00
Edward Austin "		371,124.37
Teachers' "		107,500.00
Saltonstall "		41,006.00
Letter Box "		54.00
MISCELLANEOUS.		
Students' Deposits	250.00	
Henry L. Pierce Legacy, 1898	848,000.00	
Joseph B. Glover Legacy	5,000.00	
Aug. Lowell Lab. Electrical Eng. Fund	68,000.00	
Walker Memorial Fund	703.37	
Roentgen-Ray Experiment Fund	1,000.00	
Sewage Experiment Fund	4,507.40	
Dormitory Fund	4,332.70	
Chemical Research Fund	4,891.00	
Notes Payable	25,000.00	
M. I. T. Stock Account	930,478.50	1,892,162.97
		$3,627,050.84

Comparative Statement of Funds, etc.

	Sept. 30, 1902.	Sept. 30, 1903.
Trusts for general purposes	686,850.21	686,850.21
" " Salaries	108,100.00	108,100.00
" " Scholarships	314,349.28	319,275.98
" " Library	7,000.00	7,000.00
Charlotte B. Richardson Ind. Chem. Fund	37,378.78	37,378.78
Susan Upham Fund	1,299.54	1,301.52
Susan E. Dorr "	12,956.63	14,897.01
Rotch Architectural Library Fund	5,000.00	5,000.00
Rotch Architectural Fund	25,000.00	25,000.00
Rotch Prize Fund	5,200.00	5,200.00
Rotch "Special" Prize Fund	5,200.00	5,200.00
Henry L. Pierce Legacy	803,000.00	848,000.00
Robert C. Billings "	100,000.00	
Saltonstall Fund	40,600.00	41,006.00
Aug. Lowell Lab. Electrical Eng. Fund	32,000.00	68,000.00
Rebecca A. Goddard Legacy	1,000.00	
Matilda Goddard Legacy	500.00	
Barthold Schlesinger "	2,000.00	
Edward Austin Fund	366,549.09	371,124.37
Teachers' Fund	104,000.00	107,500.00
Letter Box Fund	10.50	54.00
Students' Deposits	450.00	250.00
Roentgen-Ray Experiment Fund	1,000.00	1,000.00
Sewage Experiment Fund	5,000.00	4,507.40
Walker Memorial Fund	26,558.97	703.37
Samuel Cabot Gift Brookline Land Account	20,000.00	
Joseph B. Glover Legacy		5,000.00
Dormitory Fund		4,332.70
Chemical Research Fund		4,891.00
Notes Payable		25,000 00
M. I. T. Stock Account	841,620.64	930,478.50
	$3,552,623.64	$3,627,050.84
Increase,		
Consisting of:		
Bequests for Special Purposes, etc. (See page 4),	51,393.84	
Gifts and Bequests for General Purposes. (See page 4)	50,000.00	
Net Gain on Stocks sold	1,790.00	
Dormitory Fund, net	4,332.70	
Chemical Research Fund, net	4,891.00	
Borrowed on Notes Payable	25,000.00	
	36,432.14	137,407 54
Less Expenses more than Income	200.00	
" Students' Deposits	492.60	
" Sewage Experiment Fund, expended, net	25,855.60	
" Walker Memorial Fund, invested, net		62,980.34
		$74,427.20

INCOME FROM GENERAL INVESTMENTS, AND APPLICATION THEREOF.

Applied to Salaries	4,324.00	From Dividends, Bank Stocks	181.25
" " Scholarships	11,850.00	" State Tax returned on Bank Stocks	260.50
" " " James Savage Fund	400.00	" Bonds	63,302.50
" " Charlotte B. Richardson Fund	1,495.15	" Dividends, Railroad Stocks	1,855.00
" " Teachers' Fund	4,000.00	" " Manufacturing Stocks	1,190.00
" " Edward Austin Fund	14,400.00	" Real Estate Stocks	2,915.00
" " Rotch Prize Funds	400.00		
" " Rotch Architectural Fund	1,000.00		
" " Library	480.00		
" " General Purposes	26,710.42		
" " Samuel Dorr Annuity	1,000.00		
" " Increase of Funds	9.68		
" " Advances to Bond Premiums	3,635.00		
	$69,704.25		$69,704.25

INCOME FROM WILLIAM BARTON ROGERS MEMORIAL FUND, AND APPLICATION THEREOF.

Paid Massachusetts Institute of Technology	10,970.50	Received Income from Railroad Bonds	11,803.00
Credited to Advances Bond Premiums	832.50		
	$11,803.00		$11,803.00

DETAILS OF SOME ITEMS IN TREASURER'S CASH ACCOUNT.

Rents.

Huntington Hall, for Lowell Lectures	5,250.00	
Land and Building, Clarendon St., on account	2,000.00	
Use of Rooms and Gymnasium	2,345.43	
Cambridge Real Estate	469.60	$10,065.03

Department Supplies.

Chemistry	15,285.61	
Physics	4,748.98	
Mining	4,024.53	
Mechanical Engineering	2,608.43	
Civil Engineering	2,542.96	
Mechanic Arts	2,369.56	
Architecture	2,044.70	
Periodicals	1,904.66	
Applied Mechanics	1,560.68	
Geology	873.55	
Biology	1,272.63	
English	764.25	
Naval Architecture	839.43	
Mathematics	202.38	
Military	162.07	
Drawing	170.28	
Modern Languages	110.71	
Physical Culture	157.40	
Equipment Phys. Chem.	56.47	
Electrical Engineering	8,278.82	$49,978.10

Salaries.

Instruction	243,920.91	
Administration	37,643.09	
Labor	38,009.58	$319,573.58

General Expense.

Window Shades		296.29	
Furniture		7,440.06	
Stationery and Office Supplies		3,420.87	
Postage		3,222.59	
Electrical Wiring, Lamps, etc.		4,603.77	
Sundries		2,769.92	
Express		1,088.03	
Janitor's Supplies		2,034.09	
Examinations		676.94	
Diplomas and Commissions		519.27	
Washing		769.81	
Telephone Service, Installing Stations, Rentals, Repairs, etc.		999.50	
Engine Room Supplies:			
Oil	275.95		
Waste	108.48		
Sundries	82.28	466.71	
Library		363.33	
Ice		315.09	
Examination Books		291.54	
Examination of Title		250.00	
Graduation Exercises		181.92	
Removing Ashes		205.40	
Glass		249.90	
Union Safe Deposit Vaults (two years)		150.00	
State Street Safety Deposit Vaults		75.00	
Gymnasium		8.95	$30,398.98

Repairs.

Department Improvements:		
Chemistry	1,699.95	
Mechanical Engineering	385.76	
Architecture	177.83	
Mechanic Arts	408.11	
Physics	1,066.48	
Mining	454.56	
Naval Architecture	92.68	
Geology	77.63	
Biology	732.29	
Civil Engineering	48.64	
English	7.73	
Applied Mechanics	11.69	
Electrical Engineering	1,207.53	
Modern Languages	58.09	
Drawing	10.25	6,439.22
Rogers Building		1,718.39
Walker "		2,118.60
Sundries		1,791.98
Engineering Buildings, A and B		796.02
Mechanical Laboratories		339.54
Engineering Building, C		125.25
Lowell Building		342.17
Tech. Union		1,256.59
Pierce Building		399.57
Boiler and Power House		531.45
Gymnasium		127.80
		$15,986.58

BOSTON, December 2, 1903.

Mr. E. L. Parker, an accountant employed by this committee, has examined the accounts of the Treasurer of the MASSACHUSETTS INSTITUTE OF TECHNOLOGY for the year ending September 30, 1903, and his report is hereto annexed.

We have verified the list of personal property held by the Institute.

CHARLES C. JACKSON,
JAMES P. TOLMAN,
Members of the Auditing Committee.

BOSTON, December 2, 1903.

To the Auditing Committee of the Massachusetts Institute of Technology:

GENTLEMEN,— I have audited the accounts of Mr. George Wigglesworth, Treasurer, for the year ending September 30, 1903.

They are correct, payments duly vouched, and the receipts from students' fees and all other income duly accounted for. The cash at office and in banks, according to the deposit books, is correct. The account of property held by the Institute and the funds and balances, as shown in the Treasurer's report of September 30, 1903, is in accordance with the books.

Respectfully submitted,

EDWARD L. PARKER,
Public Accountant.

Volume 40. Number 2.

BULLETIN

OF THE

Massachusetts Institute of Technology

BOSTON

REPORT

OF THE

PRESIDENT AND TREASURER

PRESENTED AT THE DECEMBER MEETING OF THE CORPORATION

JANUARY, 1905

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TREASURER'S REPORT.

Members of the Corporation.

President.
HENRY S. PRITCHETT.

Secretary.
FRANCIS H. WILLIAMS.

Treasurer.
GEORGE WIGGLESWORTH.

WILLIAM ENDICOTT.	THOMAS L. LIVERMORE.
HOWARD A. CARSON.	A. LAWRENCE ROTCH.
CHARLES J. PAINE.	JOHN R. FREEMAN.
CHARLES FAIRCHILD.	GEORGE A. GARDNER.
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PERCIVAL LOWELL.	EBEN S. DRAPER.
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THORNTON K. LOTHROP.	ELIHU THOMSON.
CHARLES C. JACKSON.	ELLIOT C. LEE.
SAMUEL M. FELTON.	JAMES P. STEARNS.
DESMOND FITZGERALD.	LUCIUS TUTTLE.
SAMUEL CABOT.	FREDERICK P. FISH.
FRANCIS BLAKE.	FRANCIS L. HIGGINSON.
CHARLES W. HUBBARD.	CHARLES A. STONE.

W. MURRAY CRANE.

On the Part of the Commonwealth.

His Excellency, JOHN L. BATES, *Governor.*
Hon. MARCUS P. KNOWLTON, *Chief Justice of the Supreme Court.*
Hon. GEORGE H. MARTIN, *Secretary of the Board of Education.*

Committees of the Corporation.

Executive Committee.

HENRY S. PRITCHETT.
GEORGE WIGGLESWORTH. } *Ex Officiis.*

A. LAWRENCE LOWELL. HOWARD STOCKTON.
FREDERICK P. FISH. FRANCIS H. WILLIAMS.
THOMAS L. LIVERMORE.

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WILLIAM ENDICOTT. NATHANIEL THAYER.
DAVID R. WHITNEY. CHARLES F. CHOATE.
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Committee on the Society of Arts.

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HENRY S. PRITCHETT. A. LAWRENCE ROTCH.
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CHARLES F. CHOATE. JOHN R. FREEMAN.
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ELLIOT C. LEE.

Departments of Mining and Geology.

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JAMES P. STEARNS.

Department of Architecture.

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JOHN R. FREEMAN.

Department of Physics.

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Department of Electrical Engineering.

ELIHU THOMSON. FREDERICK P. FISH.
FRANCIS BLAKE. CHARLES A. STONE.
PERCIVAL LOWELL.

Departments of Literature, History, and Political Economy.

GEORGE H. MARTIN. JAMES P. MUNROE.
A. LAWRENCE LOWELL. J. B. SEWALL.
CHARLES L. LOVERING.

Department of Modern Languages and English.

JAMES P. MUNROE. SAMUEL CABOT.
CHARLES C. JACKSON. J. B. SEWALL.

Department of Mathematics.

PERCIVAL LOWELL. WILLIAM L. PUTNAM.
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Departments of Chemistry and Chemical Engineering.

SAMUEL CABOT. ELLIOT C. LEE.
HIRAM F. MILLS. CHARLES W. HUBBARD.
ELIHU THOMSON. W. MURRAY CRANE.

Department of Biology.

JOHN R. FREEMAN. GEORGE H. MARTIN.
FRANCIS BLAKE. FRANCIS H. WILLIAMS.

Department of Naval Architecture.

CHARLES J. PAINE. WILLIAM H. LINCOLN.
HOWARD STOCKTON. CHARLES G. WELD.

Report of the President.

To the Members of the Corporation:

The Report which I present to-day is the fifth which I have had the honor to bring to your attention. The year of which it contains in some measure a history has been an important and eventful one, bringing with it much of hard work, some changes, and new problems of a far-reaching character. In the solution of these problems, involving as they do questions of an educational bearing, of financial importance, and of administrative methods, all parts of the Institute constituency — Corporation, Faculty and Alumni — must share.

CHANGES IN CORPORATION AND FACULTY.

In the Corporation there has been for the year just closed only one change; the Hon. George H. Martin, Secretary of the Board of Education, has become, *ex officio*, a member of this body. The changes in the Faculty, however, have been unusually numerous. Professor Jerome Sondericker, Associate Professor of Applied Mechanics, died in mid-summer, while Professors Rambeau, Baird, Dippold, Duncan, Skinner, Whitney, and Norris have resigned. Of these, three were heads of departments, and the changes which have come from these resignations have brought problems of considerable importance in their solution. Professor Duncan is succeeded *pro tempore* by Professor Clifford, who acts as head of the department until a permanent decision shall have been reached. For the present term, Professor Vogel has taken charge of the Department of Modern Languages in place of Professor

Rambeau, Major John Bigelow having been appointed permanently to this office, his work to begin on February first. Major Fred Wheeler has succeeded Captain Baird in charge of the Department of Military Science.

Professor Sondericker was a graduate of the University of Illinois and died at the early age of forty-four and one-half years. He was a man of great kindness and of sterling character, an able teacher, and one who gave himself freely and heartily to his students. His memory will always be cherished by those who have studied under him. Mr. Kilburn S. Sweet, a member of the instructing staff in Civil Engineering, who also died in mid-summer, has left a memory which his colleagues and students are glad to cherish. His life is particularly interesting because he came into the work of the Institute under great difficulties. Born in a village in Maine, a boy of delicate frame, he came to Boston in 1889 to attend the Bryant & Stratton Business College. For a time he was employed as an errand boy in the office of the Institute of Technology, at which time he attracted the attention of one of the officers of the Corporation, who encouraged him to try the entrance examinations of the Institute. His expenses here were met by his summer earnings, by scholarships, and by contributions from friends. The outcome of his life with its fine product of usefulness and service may well encourage those who have tried to help struggling boys under similar circumstances.

THE SUBJECTS TREATED IN AN ANNUAL REPORT.

It is not always easy to select from the great mass of interesting material which is crowded into a year's programme of a large institution those topics which are most important or most distinctive. In such a statement, as in all other similar attempts, that which is material and visible to the eye is likeliest to receive attention. Changes in methods of instruction, the bringing into the institution of a fresh

mind, the acquisition of a true teacher or investigator, are all of vastly more importance in the intellectual and spiritual life of the Faculty, the students, and the graduates than the erection of a building, the addition of a laboratory, or the increase in tuition. To preserve a fair perspective of all these things is not simple. Educational and financial problems, entrance requirements, the needs of departments,—all press for representation. In the effort to deal with these varying factors and wants, one will find all sorts of solutions in the administrative reports of our larger institutions. In one the attention is given wholly to matters of detail, in another to the educational organization of the institution, while still another deals almost wholly with the larger questions of education and intellectual life. In the Report which I present to you to-day I have endeavored to bear in mind first of all the intellectual and educational needs of the Institute, but not to lose sight of the details of the Institute's life and work; and above all I invite your attention to the statements of the heads of departments in which are presented in their own words the immediate problems which in their judgment press upon them for solution. It is intended not only that these reports should serve the purpose of historical continuity, but also that they should deal with the larger topics of administration and of education.

THE ADMINISTRATIVE DUTIES ASSIGNED TO AMERICAN PROFESSORS.

No one who is familiar with American and foreign institutions of learning can doubt that the American professor has a far less desirable position than his colleague in the continental countries. Not the least of his burdens is that due to the imposition of administrative duties in addition to those of the teacher. With the growth of our institutions of learning, with the stirring competition which exists between them, with the American habit of frequent examinations, an enormous

amount of administrative work has to be done, and this is thrown in a large measure upon the professors. I am not able to give an estimate of this tax as a part of the working hours of the regular day, but there are very few teachers in the Institute of Technology who do not carry a considerable administrative load, and in many cases this load is so great as to furnish a very serious interference with good teaching, to say nothing of scholarly work and investigation. Several of our professors have returned this year from a year's absence abroad and we expect from these visits the results which ought to come from a fresh view of work as it is done in other institutions. No doubt we shall gain such results, but they will be greatly diminished by reason of the fact that these men have been harnessed at once to the administrative load which the professors in the Institute carry. To one of these was assigned the duty of editing and publishing the Annual Catalogue, a piece of work which has been done in the most admirable manner and with great promptness, but has effectually cut off any opportunity to take up the educational problems which the year's absence might most naturally suggest, problems whose solution would mean more to the cause of education and to the students in the Institute than any amount of administrative detail, however well done. The heads of nearly all of the departments of the Institute are charged with a considerable amount of administrative responsibility. The head of the Department of Mathematics is the Secretary of the Faculty, and his duties as Secretary are constant and onerous. The same thing extends to professors in the other departments, most of whom are charged with duties other than those which naturally come with teaching. All this is a part of our system of education, in which we do for students many things which are not done in foreign countries, and is due particularly to the fact that the work of administration and of teaching have no sharp line of division such as is found in foreign universities and technical schools. It seems to me evident that we must in the near future in American institu-

tions in some measure separate teachers from administrative responsibilities and administrative duties, leaving them free for the work of the teacher and of the investigator, which we sometimes forget is the real work of an institution of learning.

THE PAY OF COLLEGE PROFESSORS.

Notwithstanding the increased duties thus laid upon American college teachers, the remuneration which they receive is relatively diminished rather than increased. I ventured to call your attention to this in my last Report, and to suggest that we should need in the Institute of Technology in the immediate future to face the question of a more adequate compensation for teachers, either by the payment of larger salaries, or by the provision of retirement pensions, or by both. Sir William Ramsay, the eminent English chemist who recently visited this country, in an address delivered in New York just before he sailed, sounded a note of warning in this matter which is well worth our heed, and in which he frankly tells Americans that unless teachers are better paid the institutions of learning in this country are sure to deteriorate. I have no question that this statement is an absolutely true one and that, however large an element in the services of a teacher his devotion to the institution may be, nevertheless in a profession which is relatively underpaid there will be increased difficulty in securing good men. It is well enough to urge upon young men the attractions of a scientific career in our institutions of learning and to lead them to understand that much of the reward of the life must come from the service itself, but I fancy that few men who make these statements take the trouble to see what the financial outlay and the financial reward actually are. The fact is, under the system of specialization which has grown up in the last twenty years, a man who aspires to a professorship may count upon the following programme: First of all he must

spend four years, at considerable cost, at college or university or technical school, with some three years to follow as a specialist, including, as a rule, a year or more at some foreign institution, engaged in work which is quite as hard as that which prepares men for the law or for medicine or for any other profession. After this six or eight years of preparation, he may hope to become an assistant, or at most an instructor, in some institution of learning at a salary of seven or eight hundred dollars a year, and he will be a man of unusual attainments if at the end of ten years he has been advanced to an assistant professorship at fifteen hundred dollars a year, a salary not much better than the wages of a switchman in one of our large railroad yards. Furthermore, the chances are that during this time he will be so burdened with class-room work, with administrative duties, and with other tasks outside those properly belonging to a teacher's life that there will be little time or strength left for quiet study and research. The strenuous life has been introduced into the colleges and universities with consequences as much to be regretted as those which have come in business.

This result is due in part to the multiplication of so-called universities, to the great increase in numbers without corresponding adjustment of the organization, and to the wasteful competition in education which has come about by the great number of institutions all trying to do the same thing. Whatever may be the causes, the condition is evident enough, and some solution must be found which shall give the teacher greater freedom from the administrative side of the work and which may at the same time increase his compensation.

SELF-SACRIFICE OF COLLEGE PROFESSORS.

Under the conditions which I have partly sketched, one cannot but admire the devotion which the great bulk of college professors put into their work. Without hesitation they undertake the additional and burdensome administrative tasks with which they have been loaded, and struggle with them with such success as they may. In many cases they find themselves when past middle life crowded out by younger men, without pensions, and with little opportunity for work in their own calling. Of late years institutions of learning have demanded as remorselessly as have railroad corporations that their employees shall be under forty, and the teacher who loses his place for any cause whatsoever after he is fifty finds increasing difficulty in securing employment. Now and then a man is clear-headed enough at the very outset of his professional career to decline absolutely to be sacrificed to the god of administration. My attention has recently been called to the cases of two men of apparently equal ability, equal opportunity, and equal training, who started together as teachers and investigators. The one declined to accept administrative tasks or to surrender his time wholly to the drudgery of the daily routine; the other good-naturedly accepted at the hands of the college authorities every administrative task placed upon him. Their careers have been interesting illustrations of the working out of this régime. The first is to-day a well-known investigator, with a name established in science on both continents and with a good income; his more good-natured but less fortunate colleague is an ill-paid teacher in a second-rate institution.

STUDENT REGISTRATION AND INCREASED TUITION.

During the past five years there has been considerable fluctuation in the size of the entering classes as follows: —

1900	374
1901	440
1902	479
1903	348
1904	401

This fluctuation is the result of many factors, but is due in considerable measure to the increase in tuition which was announced in 1901 but which did not take effect until October, 1903. The very large entering class of 1902 is no doubt due to the pressure to enter before the rise in tuition should take place, the smaller number in 1903 represented the reaction after that pressure was removed, and the increase for the present year is doubtless a normal entrance class.

The distribution of students continues to be quite as wide as it has been in the past. Two very interesting groups come from the far East, six Chinese boys sent by the government of China and four Philippine students who come as wards of the country. The Chinese students are excellently prepared, having had a fair English education in China, and one of them entered the second year. This action of the Chinese government marks the return to the policy of many years ago. At that time six Chinese students entered with the Class of 1884, but were recalled early in their course. This year China is sending fifty picked students to foreign countries, nearly half of them to Japan, the rest divided between the United States and Europe.

Eight naval cadets entered the Course for Naval Constructors, so that the present group of students from the navy in the Institute numbers twenty. The number of students registering as college graduates is one hundred and eighty-two, and marks a steady and welcome growth in this direction. The colleges from which these men come are scattered over the

whole country, and this fact furnishes a gratifying evidence of the regard in which the Institute is held in other institutions of learning.

The total registration for the present term is one thousand five hundred and sixty-one, a small increase over that of last year. Of these eight hundred and eighty-nine, or fifty-eight per cent., are from Massachusetts, and four hundred and seventy-eight, or thirty per cent., come from outside of New England. Of the entire number now in the Institute five hundred and seventy-five were not connected with the school last year.

The number of graduates has now passed the three thousand mark, and amounts to three thousand one hundred and forty-eight. Two-thirds of these, two thousand and fifty-seven in all, come from the four great engineering Courses in the following proportions: —

Mechanical Engineering	688
Civil Engineering	549
Electrical Engineering	540
Mining Engineering	280

SUMMER SCHOOL COURSES.

The Summer School courses for this year included two hundred and fifty-five students as compared with two hundred and forty-five last year, and the school was somewhat further distinguished from those of former years in that it included more students from other colleges. Our Summer School, however, still remains practically a school either for the preparation of those who are about to enter or for enabling those who have not done the work adequately to supplement the regular courses of the Institute.

THE SOCIAL LIFE OF THE STUDENT BODY.

I wish to commend to the attention of the members of the Corporation the very interesting report of the Dean, in which valuable information is given as to the changing conditions in social life in the student body. The appointment of a Dean who should have time and thought to give to such questions has been one of the factors in bringing about such changes for the better as are going on. I wish to emphasize the point to which he calls attention, that is, that under the present conditions a distinctive form of student gatherings is being developed which is a wholesome one and one which tends toward culture. Of this social life the Technology Club and the Technology Union are the principal centres, and in both of these the idea is constantly developed that the student is asked into a life of moral and intellectual liberty, but a life which carries with it at the same time certain responsibilities, and always the responsibility to be a gentleman.

The action of the students in regard to athletics, their determination to enter into college athletics only so far as is consistent with their work, is a hopeful action and one which is entirely to their credit. In this day, when in most universities athletics have been so developed as to throw college life out of perspective, it is worth while to see an institution undertake the problem of entering athletic contests in a moderate and conservative spirit. The gift of the new athletic field containing a fine track and a ball field will add greatly to the interest of students in these matters, but it is not intended that this shall be the cause of any change in policy.

The statistics given in the report of the Dean as to the character of the apartments in which students live are of great interest. As is seen from this statement, over forty per cent. of the students live in their own homes, about thirty per cent. live in boarding-houses in the city proper, and about

ten per cent. in boarding-houses in the suburbs. The Dean believes from these statistics that a few dormitories accommodating a few hundred men would take care of the cases of almost all men who now live in undesirable surroundings. I trust that within a reasonable time we may have the opportunity to deal with this question.

THE HEALTH OF STUDENTS.

I wish to call the attention of the Corporation to the extremely interesting report of the Medical Adviser for the past year. It will be remembered that this office was established some two years ago, and that to it was appointed Dr. Franklin W. White, a graduate of the Institute and of the Harvard Medical School. Dr. White has entered upon his work with great zeal and intelligence, and the results have been of the most satisfactory character. Not only does he maintain office hours during which he may be consulted without expense by any student, but, in addition to this, at the beginning of each year he gives a few plain, straightforward talks upon personal hygiene, which cannot fail to be of great value, and which, together with his visitations, have brought him into admirable relations with the student body.

At my suggestion he undertook, a year ago, a somewhat extended investigation of the physical condition of the last two graduating classes, with the purpose of determining what the physical status of the men was at the time of graduation. Dr. White gives in his report the list of questions which he sent out and the nature of the replies which were received, disclosing not only the character of the daily work of the students and of their living, but also the amount of work done during the vacation period. Briefly stated, the result of his inquiry is to show that in these two senior classes nearly two-thirds of the men were never absent from class-work a day during the course, that only about ten per cent. had an illness

of any importance during their four years' course in the Institute, and that with few exceptions the men finished in good physical condition.

Dr. White's report is valuable for many reasons, but particularly as showing that where ill-health has resulted it has come almost wholly from either a neglect of physical exercise, or deficiency in the amount of sleep, or some other violation of the laws of hygiene. Such neglect ought to be greatly diminished under the system of lectures to students which is now conducted, and it is along this line that our concern for the health of students needs to be directed. For a normal, healthy boy the amount of work required is no greater than he may be reasonably expected to do.

This result, of course, does not touch the larger side of the educational question. It is entirely possible to keep a boy busy, to give him an amount of work consistent with his strength, and yet to make this work of a sort which shall be disciplinary rather than educational. Against this tendency the technical school needs particularly to watch; and the Faculty is giving its attention from time to time to this matter, making constant examinations of the Courses to determine how they may be made more efficient and how the load may be distributed in such wise as to suit best the needs and the aims of the students.

The whole result of Dr. White's examination is to emphasize the need of cheap and comfortable quarters for that part of the student body which now lives under poor conditions in a quarter of the city not favorable for their social life, and who obtain their board where either insufficient or poor food is often provided.

THE PRESSING NEED FOR ROOM.

I ask your careful consideration of the individual reports of the heads of the various departments, in which they have stated in their own words their condition and their needs. These reports emphasize certain of those things to which I have already called attention, namely, the need for more teachers of the higher grades rather than for additional assistants, and the need of increasing salaries to the point where men may get a fair compensation, together with a fair certainty of provision for old age. Throughout all these reports one need is made evident as the most pressing and immediate, and that is the necessity of additional space. Professor Swain, in his report of the Department of Civil Engineering, states as the first need of his department that of additional space. Professor Lanza refers to the crowded condition of the Department of Mechanical Engineering. Professor Richards says that "to do its present work to the best advantage the Mining Department needs double its present floor space." The Department of Architecture, although installed in its quarters but a few years, finds itself cramped for room. Professor Talbot says, "The need for more adequate accommodation for the work of the Department of Chemistry is more keenly felt each year. Not only are certain branches of the instruction suffering from the congested state of the laboratories allotted to them, but the department as a whole is lessened in efficiency because of the isolation of portions of its work in separate buildings (four in all), away from the chemical library and sources of supplies, and so widely distributed that community of interest among the members of the department working in different lines is seriously diminished. A reunited department in a building designed for the purpose of chemical instruction, with the much-needed supply of small laboratories for research, advanced or special work, is imperatively needed to permit of the development of the departmental work, which has been for some years and is still prohibited by

the impossibility of attempting more in the space at command." Professor Sedgwick asks for one additional room for the Department of Biology. Professor Cross calls attention to the congested condition of the Physical Laboratories, saying "It will be seen that we have practically reached the limit of the capacity of the present Laboratories of General Physics, as a further increase of size of sections, even with a proportional increase in the number of instructors, will unquestionably result in less satisfactory work. To meet, therefore, any further material increase in the size of our classes the laboratory equipment will have to be duplicated and installed in separate rooms, so that independent sections can be accommodated simultaneously." In a word, an inspection of the reports of the heads of departments here presented will show that, in their judgment, we are dealing in our present buildings with as many students as can be efficiently taught in the space at our command, and that for any increase in numbers, and, indeed, for the proper teaching of the present number, we ought to have additional buildings. The pressure for more rooms for lecture halls and laboratories is one of the most difficult questions with which the Faculty and executive officers of the Institute have to deal.

SUITS IN REFERENCE TO THE INSTITUTE'S LAND.

The question of meeting the need to which I have just referred, that of additional buildings, is closely connected with the possible success or failure of the suits which have been brought against the Institute to test the validity of the Act of the Legislature conveying to the Institute the title to its site on Boylston Street in fee simple. As the members of the Corporation are aware, three suits, one by the Massachusetts Society of Natural History and two by owners of abutting property on Newbury Street, have been brought to determine the quality of the Institute's title under this Act. The first

of these suits was argued during the summer, while the last two were argued during the present month, before the Supreme Court. How soon a decision may be expected I cannot say. Should that decision be favorable, the Institute could meet the immediate demands for space by the erection of additional buildings on the vacant portions of the land in question; but, if the suits should be decided against us, the value of the State's gift would be very materially diminished and the problem of furnishing the additional buildings needed for our work would be an entirely different one, and one which would require the earnest consideration of the members of this body.

HARVARD-TECHNOLOGY CONFERENCES.

On May 4, 1904, a Resolution was passed by this body, to the following effect: "That the Executive Committee be requested to ascertain whether any arrangement can be made with Harvard University, for a combination of effort in technical education, such as will substantially preserve the organization, control, traditions and the name of the Massachusetts Institute of Technology." Acting under these instructions, the Executive Committee appointed a conference committee of two to confer with a similar committee from the Harvard Corporation. Repeated conferences have been had by these two committees, and I am able to report that they have practically agreed upon recommendations which it is hoped may be submitted at an early date to the Corporations of both institutions. The discussions and deliberations of these committees have been conducted upon a plane in which there was preserved not only loyalty to the institutions themselves, but a real desire to serve the higher interests of education and of the State. Neither side has sought to lessen the dignity or the freedom of the other. Any discussion of this matter must necessarily wait until the final report can be presented. I shall hope to give in my next Report a complete

statement of the entire matter. For the present I can only express the hope that, notwithstanding the fact that this proposal has aroused sharp differences of opinion among friends and alumni of the Institute, when the definite proposition has been made known, and when a full and free discussion has been had, we may find ourselves coming, whether we decide in one way or the other, to a fairly accordant result. Whatever else may happen from the discussion of this question, it is most essential that no harm shall come to the Institute itself, and that those who work for it and believe in it, whatsoever their opinion regarding this matter, may in the end unite for the common development and progress of the school.

THE GENERAL PROBLEM OF THE INSTITUTE.

The sketch which I have here given of certain questions of policy or of education which are pending, while incomplete, is, nevertheless, sufficient to show that the Institute has before it large and important questions to solve. These questions are, in the first place, educational. Nothing else is of so much importance to any institution as to maintain a scholarly spirit and an atmosphere which while full of enthusiasm shall be free of dogmatism; a spirit of work which shall be strong but wise; and a co-operation between all parts of the institution which may help to the intellectual and moral upbuilding of the student body. Those things which have to do with the freshening of the methods of instruction, with the improvement of the Courses, with the introduction of higher ideals of work and of study, are first in importance and fall in the main to the Faculty; but closely connected with them are all the secondary problems which have to do with the means and the material facilities for carrying out the work of the Institute. So soon as the suits now pending against the Institute are decided, it seems to me clear that we should settle upon a general policy as to the Institute's location for

the next ten or twenty years, that we may then bend our energies without distraction to the improvement of its work and of its facilities, to the end that it shall be made, to the very best of our ability and means, a place which shall be stimulating and helpful to the students who resort to it. This general question of policy as to where the Institute's work shall be done for the next twenty years is one which should be settled as promptly as the conditions will allow.

TREASURER'S REPORT.

In the course of my statement I have said comparatively little as to the details of the financial conduct of the Institute, first, because I conceive it to be my work to deal in the main with the educational problems and needs of the Institute, and to convey to the Corporation as well as I may the expression of the purpose and aims of the Faculty; and, secondly, for the reason that the financial status of the Institute is admirably presented in the report of our Treasurer, which contains a complete exhibit of the operations of the past year. Like most educational institutions in the East, we present a deficit at the end of our year's operations. Except the State universities, which are by law restricted to the expenditure of fixed sums, most institutions which are growing in numbers and in work show such deficits for the past year. I invite your attention to the items which make up this exhibit and to the statement of the Treasurer in connection therewith.

HENRY S. PRITCHETT.

DECEMBER 10, 1904.

Reports of Departments.

REPORT OF THE SECRETARY OF THE FACULTY.

The recent reorganization of the administrative work of the Institute has made it the duty of the Secretary of the Faculty "to co-operate with the President in the general conduct of Faculty business and administrative work, and to have general oversight of the work of the Registrar and the Recorder." This report is accordingly occupied mainly with a review of such Faculty business of the year as may be of general interest. Some of the larger matters represent the work of special or standing committees of the Faculty.

Changes in the curriculum connect themselves mainly with the discontinuance of the former Course IX., General Studies, and the effect on all Courses of the advance in entrance requirements in modern languages. In February the Faculty was advised of action by the Executive Committee of the Corporation terminating Course IX., after its completion by students then in the Institute, and requesting the Faculty to take the necessary steps for the substitution of an elective Course in general science, the first year of this Course to be in the main that required of other students, the last three years to be given to studies under a free election. These steps have since been taken, but no students are yet registered in the Course.

The advance in entrance requirements in French and German, taking effect in 1903, leads to the completion of modern languages by students of the classes of 1907 and later years at the end of the second year instead of at the end of the third year as heretofore. In the case of Course III., however, it has been deemed necessary to postpone the German from

the second year to the third. In recognition of the fact that modern languages in the Institute curriculum have value as general studies apart from their utilitarian purposes, the Faculty determined that, for the two hundred and seventy hours formerly assigned to exercises and preparation in the third year of French and German, one hundred and twenty hours should be allotted to general studies, with options in various lines, including the history of science. Adjustment of the numerous diverse interests and preferences involved has been a matter of some difficulty, but a definite plan will be presented to the Faculty at an early date for announcement in the forthcoming Programme. It is anticipated that this re-enforcement of the general studies with opportunity for free choice on the part of the students will result in much advantage. The use of the time released for professional subjects has not yet been determined, but will depend mainly on the initiative of the heads of the professional departments. The Course Schemes of the present Catalogue thus represent to some extent a transition stage for students some of whom have entered under the present, others under the former language requirements.

A further recent change in entrance requirements, the addition of physics, has led to the holding of examinations in that subject last summer for a limited number of preliminary candidates and to the substitution of biology for physics in the list of elective subjects in which teachers' certificates are accepted without examinations. It is anticipated that the entrance requirement in physics will tend to relieve the difficulty which has resulted from the corresponding increase in subject-matter appropriated for presentation in the second-year course. These recent changes of entrance requirements have made the test of a candidate's fitness for the Institute work more complete, without creating a gap between the better high schools and our first year. It may be noted, however, in passing that there are evidences of an unfortunate tendency in some quarters to restrict Institute candi-

dates to one among several public high schools of particular cities.

The Summer Courses for the past season were begun at a somewhat later date than usual, with a view to accommodating college graduates and other persons unable to attend before the end of June, and also with a view to facilitating the administrative routine in the case of Institute students whose plans might depend upon the results of their June reports. Attendance upon the summer courses has shown with some fluctuation a general tendency toward increased usefulness, but it is more and more evident that care should be exercised to guard against the disposition of dilatory students to postpone the work of the school year with the often delusive hope of making it up in the vacation. In the case of accidental loss of term work, the summer courses have proved the means of obviating serious hardship, not infrequently saving an entire year for students.

The two most notable events of the year, not merely for the Faculty, but for Institute men generally, have been the Technology Reunion of last June and the Rogers Commemoration of December. While the Reunion was primarily an alumni affair, the Faculty was represented on the Committee of Arrangements, and many of the alumni members of the Faculty were actively engaged throughout the whole undertaking. The closer relations between Faculty and alumni which the Reunion promoted cannot fail to exert a lasting influence for good.

The Rogers Commemoration was given the character of a presentation of the life and work of the founder of the Institute to its present undergraduates. The exercises of the school were suspended and addresses delivered to an audience filling Huntington Hall, and including, beside the undergraduates, members of the Corporation, Faculty and instructing staff, associates of President Rogers in the early years of the Institute, and a small number of guests invited for personal reasons. The addresses are to appear in full in an early

issue of the *Technology Review*. The Commemoration as well as the subsequent commemorative meeting of the Alumni Association have contributed powerfully to make President Rogers' influence a living one to men most of whom knew him only by name.

The work of the Committee on Publications has been notably important the present year. The Catalogue and Programme have been radically changed in form by substituting for the former tabular Schedule of Topics an extended description of courses, of special value to students desiring admission with advanced standing. The committee has adopted the policy of issuing the Programme early in the summer, the Catalogue early in December, and the Register of Graduates in March. The latter has appeared this year for the first time as a distinct publication, making with a geographical register a book of two hundred and fifty-seven pages. The earlier issue of the Catalogue, facilitated by the omission of the Register, has been a considerable gain. For these and the President's Report the committee has adopted a serial form of publication.

The work of the Faculty Committee on Undergraduate Scholarships has grown steadily in difficulty and importance, and the need of additional resources becomes more and more urgent with the increased proportion of students responsible for the higher tuition fee. The committee has at its disposal from $25,000 to $30,000 per year at this time, and could use fifty per cent. more with much advantage, without taking account of the considerable number of earnest students who are led to give up coming to the Institute altogether by reason of the cost. The number of applicants for whom awards have been made by the committee for 1904–05, not including the Massachusetts State scholarships, has been one hundred and seventy-four, the amount awarded, $17,250, an average of $98.57. The forty State scholarships have been assigned to seventy-three candidates, sixty-six receiving half-scholarships.

The Committee on Advanced Degrees and Fellowships has

also experienced in recent years a marked increase in the amount of its business and responsibilities. The appropriations recommended by the committee for the current year have amounted to $5,000 distributed among sixteen persons, ten for resident, six for foreign study; in four instances the awards recommended have been subsequently declined on account of changes in the applicants' plans.

The Committee on Recommendations for Appointments of Graduates has not attempted to expand the scope of its work materially for the cogent reason that under existing industrial conditions the demand for graduates is considerably in excess of the possible supply. It has seemed therefore unnecessary and indeed inexpedient to take any steps which should increase the demand in the absence of an adequate supply. On the other hand, efforts have been made to systematize the committee's correspondence in such a manner as to secure prompt information whenever men have been available. Many of the applications come from other institutions desiring teachers, but the number of Institute graduates who look toward teaching is still smaller than could be wished.

While the matters just outlined connect themselves with the work of every year, there is in each year a considerable number of scarcely less important items which do not recur. One of the most burdensome items for the present year has been the preparation of the Institute's main and collateral exhibits for the Louisiana Purchase Exposition at St. Louis. The main exhibit of the Institute was installed in the Educational Building under the direction of Professor H. W. Gardner. The exhibit was in place and in good order on the opening day of the Exposition. From that time until December first, the day of closing, the exhibit was under the personal care of some present or former student of the Institute. The following men have had charge of the exhibit during periods varying from ten days to two months: Messrs. J. S. Weil, F. M. Chace, J. A. Root, G. B. Jones, E. Burton, C. A. Johnston, R. H. Allen, E. L. Smith, and A. H. Kell-

ing. This arrangement was found to be economical and satisfactory from every point of view. Special thanks are due to these students for the intelligent and conscientious way in which they have fulfilled their duties. The awards reported include,— Grand Prize for General Exhibit; Gold Medal for Mining Engineering Exhibit; Silver Medal for Special Exhibit of Department of Analytical Chemistry; Silver Medal for Special Exhibit of Drawing; Silver Medal for Special Exhibit of Photographs and Students' Work.

Among other items the following subjects have received the attention of the Faculty: the procedure at the end of the term in connection with the consideration of records, the printing of theses, the restriction of the number and length of final examinations in the fourth year, the policy to be adopted in regard to the substitution of work in other languages, particularly Spanish for French and German, and the enforcement of a somewhat higher standard for admission to fourth-year professional subjects.

In connection with the statistical report of the Registrar, attention may be called to the fact that not less than one hundred and fifty-eight students, including seventy-seven graduates, have entered the Institute the present year from other colleges.

The number of students required to withdraw in consequence of low standing in scholarship was as follows. In January, 1904: Fourth Year, 4; Third Year, 1; Second Year, 7; First Year, 2; Total, 14. In June, 1904: Fourth Year, 0; Third Year, 11; Second Year, 16; First Year, 11; Total, 38. Total for the year 52. In addition to these, three students were required to withdraw for other reasons.

H. W. TYLER.

REPORT OF THE DEAN.

During the past year there has been a general increase in the work of this office. The chief duty of the Dean seems to be to act as a general consulting officer.

As in former years, each new student has been referred to

some member of the Committee of Advisers. This Committee numbers sixty, and has been made up this year largely from the younger members of the instructing corps, as being in closer touch with new students. On the two days preceding the opening of the term the Committee met new students in the General Library and gave assistance in arranging their programmes of work and in introducing them to the rather complicated system of registration. In this latter work the Committee was assisted by a number of the older students.

Students at the Institute thoroughly appreciate the difficulty of forming acquaintances among their own number. At the beginning of the year they accordingly arranged several informal gatherings to which all new men were invited. In addition to this, in October, 1904, the Walker Club, a society devoted to fostering interest in non-technical studies, gave a special reception to all students entering from other colleges. About one hundred and seventy invitations were sent out, and there was a large and representative gathering of men who entered this year from different American and foreign colleges, a large majority being graduates.

The social life of the student body is improving every year. Each of the larger professional Courses at the Institute has an active society holding frequent meetings. Many informal dinners of the classes and other organizations are held at the Tech Union. Among these are two notable gatherings of students from different classes, one called the Field Day Dinner, to which all participants in this contest between the first and the second-year students are invited, and the other to which are invited all those taking part in the "Tech Show," a performance in which the participants are drawn from every class and professional Course. At the former about one hundred and fifty were gathered, both the victors and the vanquished celebrating the event on the friendliest terms. To see freshmen and sophomores mingling together in the best of good fellowship after an exciting contest in which class feeling has reached its highest pitch is believed to be a unique

spectacle in an American college. The "Tech Shows" have been given for the last six years, and have attracted the general interest of the student body. The proceeds are devoted to the needs of the Athletic Association. Over one hundred men take part in these shows.

These items in regard to the social life of students are placed in this report because the general public is disposed to think that there is no so-called "student life" at the Institute of Technology. This opinion is due in great part to the fact that the student body has withdrawn from the intercollegiate football and baseball contests and is therefore not brought so frequently to public notice. The students themselves have recognized that there is not time for the development of teams such as can compete satisfactorily with the large colleges in the East, and have held to track athletics as the most suitable expression of the athletic spirit at the Massachusetts Institute of Technology. Under the able management of an alumni Advisory Council, track athletics have flourished and gained considerable attention from a large number of students. Cross-country running, fostered by frequent hare-and-hounds runs, has aroused a strong interest, and several sports, such as hockey, basket-ball, fencing, and general indoor athletics, engage the attention of a fairly large number. The gymnasium, totally inadequate to the whole number of students attending the Institute, is, however, quite large enough for those living in the near vicinity of the city proper.

The Technology man is much more social and gregarious in his habits than he was a few years ago. The affairs which receive the most enthusiastic support are those that appear to have the most distinctive and unique character. The Technology man is not inclined to be imitative, but, if he can originate and build up for himself some custom or tradition, he is likely to support it with great fervor. There is a strong, manly quality that influences the tone of the large social gatherings and is indicative of the temperament of the student body.

The room and boarding-house register, consisting of a list of two hundred and thirty houses in Boston and vicinity, was consulted quite generally by new students, and an increasing number availed themselves of accommodations in the immediate suburbs. It may be of interest in this connection to give a brief summary of the residence of the students for the year 1904–05 : —

Living at Home	685
Living at Chambers or Bachelor Apartments	138
Living at Fraternity Houses	139
Boarding in City Proper	453
Boarding in Suburbs	146

Many of those living in the city proper are in houses where four or more students are gathered. Comparatively few are completely isolated from their fellow students. In the case of those who are trying to practise great economy, accommodations are often inadequate and uncomfortable, the surroundings far from improving, and the food insufficient. The total number of such cases, however, is not great, and a few good houses which could accommodate less than a hundred men would probably solve this difficult problem.

The employment bureau has not been so successful in finding professional work for undergraduates during the past year as in previous years. The majority of those who obtained work were obliged to seek it in other fields than those connected with their Institute Courses.

Gymnasium.— The attendance at the Gymnasium in the regular classes last year varied from ninety to twenty a day, the average attendance during the first six weeks being sixty-four, and during the last twelve weeks eighty-six. Over one hundred and twenty-five students have taken regular class-work. Of the whole number receiving instruction, 10 per cent. were fourth-year men, 15 per cent. third-year, 20 per cent. second-year, 30 per cent. first-year men, and 25 per cent. special students. In addition to the students who take regular class-work, about one hundred and fifty men use the

gymnasium irregularly and have lockers there, and the track team uses it during the winter for practice.

At the beginning of the school year one hundred and sixty-four men received a physical examination in which twenty-four measurements were taken, the different sets of muscles tested by dynamometers, and special attention given to the heart and lungs. A very few students were found to have a slight heart or lung trouble, and these were referred to the Medical Adviser. From these measurements and strength tests an anthropometric chart was plotted for each student. This chart shows clearly what parts of the body are defective in size and development. A second examination was made at the end of the year. This also was plotted on the same chart, and indicates the increase in strength and development during the school year. The Cabot medals for physical improvement were awarded on the basis of these charts and the record of attendance during the year. The Committee of Award consisted of Professor Wendell, Mr. Towne, Mr. G. Defren, and the Dean. Medals were awarded in May, 1904, to J. P. Stow, Jr., '07, F. B. Poole, '05, and J. C. Damon, '04. During the present year it is planned to form a gymnastic team for competition with other college teams, and it is hoped that these contests will add interest and enthusiasm to the routine work.

STATISTICS OF ILLNESS FOR THE SCHOOL YEAR 1903-1904.

Fourth-year Class.

There were three hundred and twenty-two students, regular and special, in the fourth-year class. Of these twenty-one were reported ill during the school year 1903–1904. Classified by diseases, there were the following cases: chicken-pox, 2; grippe, 2; malaria, 2; typhoid fever, 3; tonsillitis, 1. There were four cases more trivial in character, and seven in which illness was not specified. One member of this class, Mr. John A. Fremmer, died, Aug. 8, 1904, of peritonitis.

Third-year Class.

The whole number of students in this class was three hundred and eighty-two. Of this number forty-three were reported ill during the school year. Classified by diseases, there were the following cases: appendicitis, 2; grippe, 2; hernia, 1; jaundice, 3; measles, 2; pneumonia, 2; scarlet fever, 1; tonsillitis, 2. Seven cases were less important, and twenty-one were not specified. There was one death in this class, that of Mr. G. E. Dunham on January 24, 1904, who died at the Massachusetts General Hospital of pneumonia.

Second-year Class.

The regular and special students in this class numbered four hundred and fifty-eight. Forty-four of these were reported ill during the school year 1903–1904. Classified by diseases, there were the following cases: appendicitis, 3, one of which was treated at the Massachusetts General Hospital; bronchitis, 1; congestion of the lungs, 1; grippe, 4; heart trouble, 1; incipient consumption, 1; measles, 2; malaria, 1; mumps, 1; nervous trouble, 3; neuralgia, 1; water on the knee, 1. There were ten cases of a less serious nature, and eleven cases in which illness was not specified.

First-year Class.

The first-year class numbered three hundred and forty-eight. Of this number forty-nine were reported ill during the year. Classified by diseases, there were the following cases: appendicitis, 2; chicken-pox, 1; eye trouble, 3; fever, 2; grippe, 3; incipient consumption, 1; jaundice, 1; mastoid operation, 1; measles, 3; mumps, 2; nervous trouble, 3; pneumonia, 1; tonsillitis, 6; typhoid fever, 2. Five cases were unimportant, and the remaining thirteen were not specified.

SUMMARY.

	No. in Class	*No. Ill.*	*No. of Deaths.*
Fellows and Graduates	18	—	—
Fourth Year	322	21	1
Third Year	382	43	1
Second Year	458	44	–
First Year	348	49	–
	1,528	157	2

ALFRED E. BURTON.

REPORT OF THE MEDICAL ADVISER.

Office hours have been held in the Peirce Building twice a week throughout the school year. The time set apart for medical visits has been fully utilized, and the work of the Medical Adviser has steadily increased.

Late in the fall of 1903, it was found that more students came for advice at every office hour than could be seen between four and five o'clock, and, in order to provide for this increased number of students, a plan was suggested by the President which has been carried out since the middle of January, 1904. The time of consultation, instead of being limited to one hour, was extended, when necessary, so that each student who came for advice on a given day should get it. The increase in medical work is shown by the fact that in 1903 one hundred and thirty-one men were treated in the second term, and in 1904 two hundred and eleven. This increase required seventeen hours of extra work, or an average of about one-half hour on each occasion. The time spent per day has, naturally, varied. On eight occasions no extra time was needed, and on eight occasions it took an extra hour to see all the students who came for advice. The new plan has proved a satisfactory way to provide for them all.

The following table gives the number of office visits made and the number of students seen. A few figures for the year 1902–1903 are put in for comparison.

	1904.	1903.
Total number of office visits made	349	254
Total number of different students seen	185	156
Greatest number of students seen per day	11	
Least number of students seen per day	2	
Average number of students seen per day	6	5
Number of students making more than one visit	47	

All the students seen were men, and, as in previous years, the majority found it necessary to come only once, usually for the treatment of some acute and promptly curable condition. Only four students made more than five visits apiece; two of these were surgical cases requiring frequent dressings, and

two were cases of bone tuberculosis, who ultimately left the Institute.

The average number of students seen per day was six. This seems to me as large an average number as can get satisfactory individual attention within the hour.

The following table shows the kind of diseases treated and the number of each: —

CLASSIFICATION OF DISEASES.

Surgical Cases, 35.

Abscess	12	Arthritis	2	Contusion	1
Crushed foot	1	Cut	5	Curvature of spine,	1
Cyst	1	Flat Foot	1	Hermatoma	1
Hernia	2	Ingrowing toe nail	1	Sprain	1
Septic finger	4	Synovitis	1	Wart	1

Nose and Throat, 23.

Coryza	9	Pharyngitis	7	Nasal spur	1
Laryngitis	2	Hypertrophy of tonsils,	1	Post-nasal catarrh	3

Stomach and Bowels, 19.

Acute indigestion	2	Constipation	8	Gastric neurosis	3
Intestinal indigestion,	2	Piles	2	Simple diarrhœa	2

Eyes, 15.

Conjunctivitis	6	Foreign body	2	Imperfect sight	6
Pterigium	1				

Skin, 14.

Acne	1	Dermatitis	1	Eczema	3
Herpes	2	Psoriasis	1	Pediculosis	1
Scabies	3	Ringworm	1	Urticaria	1

Specific Infectious Diseases, 14.

Appendicitis	2	Grippe	2	Malaria	2
Measles	1	Tonsillitis	6	Typhoid	1

Lungs, 12.

Asthma	1	Pulmonary tubercu-		Pleurodynia	2
Bronchitis	6	losis	2	Pleurisy	1

Ears, 9.

Impacted cerumen	3	Polyp	1	Otitis media	5

Genito-urinary, 8.

Albuminuria	2	Balanitis	2	Gonorrhœa	2
Periurethral abscess	1	Varicocele	1		

Heart, 2.

Cardiac neurosis	1	Pericarditis	1		

Miscellaneous, 36.

Civil Service Exam.	7	Debility	15	Insomnia	2
Jaundice	1	Lumbago	1	Neurasthenia	10
Athletic Team Exam.,	6	Advice about Tropics,	1		

A large number of conditions was treated, the most numerous being surgical diseases, digestive disturbances, diseases of the nose and throat, and of the eyes. About a dozen men suffered from severe illnesses, such as appendicitis, typhoid fever, Bright's disease, and crushed foot, which were more or less completely cured after appropriate treatment. Two men had to leave the Institute on account of pulmonary tuberculosis, and two on account of heart disease. Most of the illnesses, however, were acute and promptly curable. A small number of students was referred to specialists for treatment of the eye, ear, or skin. A small number of students was recommended for admission to the Massachusetts General Hospital, where the Institute has free beds, for the treatment of such acute diseases as appendicitis, grippe, typhoid, malaria, pleurisy, etc.

In addition to the work at the Institute office, I have seen about forty sick men at my private office and have been called to attend a smaller number of men at their homes.

The number of cases of contagious diseases among Institute men has been very small; there were seven cases of measles, three of mumps, one of scarlet fever, and three of chickenpox. As it was discovered, however, that there was a strong tendency among the students to cut short the necessary period of isolation after contagious diseases and return to their work, an arrangement was made that each student after recovery from any contagious illness should see the Medical Adviser and obtain from him a signed card stating that he had recovered from his illness and was in a fit condition to return to his classes, and it was required that this card be shown to the Dean and instructor when beginning work.

In addition to students who were sick, thirteen healthy men were examined for the United States Civil Service or for athletic teams.

A lecture to the first-year class on the hygiene of student life was given by Professor Sedgwick and two talks on personal hygiene by the Medical Adviser, covering the following

topics: bathing, clothing, exercise, sleep, care of the eyes, the use of tobacco and alcohol, minor ailments, such as constipation, headaches, colds, etc., and emergencies. After a consultation with the President and others, it was decided to add to the above topics a short talk on the prevalence and dangers of venereal diseases. In addition to the lectures and actual work of caring for sick students many letters of parents have been answered, advice has been given to instructors and students about isolation in case of contagious diseases, and an inquiry has been made about the health at graduation of the last two senior classes, to determine, if possible, the effect of the Institute course upon their general health and fitness for mental and physical work.

In January, 1904, a letter was sent to each of the graduates of 1903, stating that information for statistical purposes was desired concerning the health of the last graduating class. The following questions were asked: —

1. Were you absent from class for more than a day at a time on account of illness during your course at the Institute, and, if so, in what year?
2. Did you have difficulty in keeping in reasonably good physical condition?
3. Did you take any regular exercise?
4. How many hours did you allow for sleep?
5. Are you up to your usual weight?
6. How many hours of study a day outside of class-work were necessary?
7. Did you do any work in addition to your work as a student?
8. Did you work through the summer vacation?
9. Did you find the work at the Institute difficult? Was any year especially difficult?
10. Did you take a vacation after graduation? How soon did you begin actual work?

Replies were received from a majority of the class of 1903. Similar information was obtained from nearly all the members of the graduating class of 1904; and in addition the

graduates were requested to report in person to the Medical Adviser, in order that he might make a better estimate of their physical condition at the end of the Institute course. One-half of the class reported in person.

Information was obtained in all from about three hundred men, and the two classes will be considered together in one joint report.

One hundred and sixty-eight men were never absent on account of illness during the four years' course. Ninety-four men were out for a few days on account of slight illnesses. Twenty-nine men were out for a week or more with acute illnesses common among young people, such as appendicitis, measles, mumps, typhoid, grippe, malaria, diphtheria, etc. This was no more illness than one might reasonably expect in four years in such a body of young men under favorable conditions.

Thirty-six men said that they had difficulty in keeping in good physical condition, and in many the cause was not far to seek. Sixteen of these men allowed only six or seven hours of sleep, and twenty-five did not take any regular exercise. One man travelled sixty miles a day by rail and had cold luncheons. Six of them did outside work during the school year, and twenty-four worked through the summer vacation. Of the class of 1903, only five, however, considered a vacation at the end of their course a necessity. All the rest were at work within a month of graduation. It is evident that even the weaker members of this class finished their Institute course in reasonably good condition.

One hundred and seventy-five men took no regular exercise: one hundred and twelve men did. In thirty-nine of the latter cases it was limited to daily walks.

The average number of hours allowed for sleep was seven and one-half hours by the class of 1903, and eight hours by the class of 1904. Seventy-two allowed seven hours or less; only thirty-three allowed over eight hours. There is an evident strong tendency to cut short the hours of sleep, and my

experience with the men makes me feel sure that this is done largely for the sake of work, rather than amusement.

Sixty-five men, or about one-fifth of the whole number, did some outside work during the school year, as draughtsman, tutor, reporter, telegrapher, sexton, etc., or in connection with Institute publications or societies. Two hundred and sixteen men, or over two-thirds of the whole number, worked through the summer vacations in one or more years.

The average daily number of hours of study outside of class-work was three and three-quarters hours, the extremes being one, and eight hours per day. One hundred and one men when asked if the work at the Institute was difficult said "no," a few considered it easy, the majority thought it was "about right," "medium," "neither hard nor easy," or "difficult in parts." The third year was usually considered the hardest. Nine men thought the first year the hardest, twenty-two men the second year, ninety-five men the third year and fifty-six men the fourth.

Of the eighty-five men of the class of 1904 who reported in person, one-quarter were in excellent physical condition, nearly three-quarters were in good physical condition, and only one man was evidently over-tired.

To sum up, this inquiry into the health of the senior classes shows that nearly two-thirds of the men were never absent from class-work on account of illness a day during the course, that only about ten per cent. had an illness of any importance during the four years, and that with very few exceptions the men finished in good physical condition and were ready for work as soon as they could get it.

It is evident that a large number of the men in their enthusiasm for work did not take very good care of themselves; a majority neglected physical exercise and worked through their summer vacations, and more than one-third allowed less than eight hours for sleep. These mistakes in hygiene are specially striking in the small group of men who spoke of having some difficulty in keeping in good physical condition.

The Medical Adviser hopes that the talks on personal hygiene to the entering class and his interviews with students during the year may help to remedy these conditions.

FRANKLIN W. WHITE, M.D.

GRADUATE SCHOOL OF ENGINEERING RESEARCH.

Concerning the Graduate School of Engineering Research only a few words need be said. Several inquiries have been received during the year concerning the school, and especially concerning fellowships in it, but, as a rule, these have come from persons obviously unprepared for the high grade of work expected, and no one has this year been registered, either as a member of the school or as a candidate for the degree of Doctor of Engineering.

It is an interesting fact that very few persons in the United States appear to be either desirous or ready as yet to pursue special researches in engineering science. Reasons for this fact are not difficult to conceive, for the largest and most interesting examples of engineering work are to be found only in actual practice, and these therefore, combining as they generally do the attractiveness of novelty and a practical character with size, can hardly fail to compete successfully with experimental work in engineering institutions. Much of the interest and satisfaction of experimentation can often thus be realized, at the same time that the engineer is earning his living or perhaps receiving substantial financial rewards. In these respects engineering research is likely always to be handicapped, and to differ from research in pure science, which must usually be carried on without hope of reward and without other possibilities of realization than under academic, or at least under endowed, auspices. The fact that none of our own graduates has as yet applied for membership in the Graduate School of Engineering Research is, I think, especially interesting and significant, but, in spite of the obvious

difficulties involved in the plan, I believe that the maintenance of the school is important, as an exhibit of a kind of work greatly to be desired at present, and of a standard which ought to be realized in the future.

W. T. SEDGWICK,
Secretary of the Council.

DEPARTMENTS OF CIVIL ENGINEERING AND SANITARY ENGINEERING.

The year just passed has been a successful one. The class graduating in June numbered thirty-six, which was eleven more than the previous class and the largest class ever graduated, with the exception of that of 1901. If these men have not all found positions, it has not been because of any lack of demand, although, on account of the business depression, the demand for our graduates has been less active than during the past few years. The following table shows the applications received by the department from April to August, inclusive, in 1903 and in 1904: —

	1903.	1904.
Railroad	39	9
Structural	19	7
Teaching	7	7
Hydraulics	3	9
Miscellaneous	24	15
Total	92	47

Since August last, however, the demand for our graduates has increased, and many positions have been offered, which could not be filled. It will be noticed that even this year the number of positions offered exceeded the number of students available and, moreover, many graduates obtained positions through their own efforts, so that there were probably twice as many applications as men to be supplied. We already have applications filed in advance for men of the Class of 1905.

The staff of instruction has suffered a great loss during the year by the death of Mr. Sweet, who has been an assistant or

instructor in hydraulic engineering since 1893. Mr. Sweet was a young man of high character and excellent ability. He carried on his work with great care and conscientiousness, and his modest bearing and quiet, unassuming demeanor won for him the affection of both teachers and students. The vacancy caused by Mr. Sweet's death has been filled, temporarily, by the appointment of Mr. S. H. Thorndike of the Class of 1895, as Instructor in Civil Engineering. Mr. Thorndike has been engaged for a number of years in responsible work in the office of the City Engineer of Boston, and will not entirely relinquish his work with that department.

Five of the assistants of last year resigned their positions to engage in outside work. Their positions have been filled by five graduates of the Class of 1904.

It is the policy of the department to encourage the men on the teaching staff to engage in outside work during the summer vacations, and a number of the members of the staff devoted the past summer to such pursuits. Professors McKibben and Spofford have permanent summer occupations. All of the instructors were also employed, Mr. Breed having been in the employ of the Chicago and Eastern Illinois R.R., in charge of some of the work of elevating the tracks in Chicago for the elimination of grade crossings, and Mr. Hosmer having been in the employ of the city of Cambridge. Mr. Sweet was employed at the time of his death. Of the six assistants four were employed during the whole or part of the summer. The importance of this work for members of the teaching force is very great. It not only enables them to look at engineering problems from the practical and economic point of view, but it enables them to arouse more enthusiasm among the students and to command greater respect from them.

The needs of the department may be specified as follows:

1. We need additional space. The Engineering Library is very much cramped and there is room for only thirty or forty men at the most to be seated at tables, while the fourth-year

class in civil and sanitary engineering alone comprises about seventy men. The bookcases are very nearly filled and in a short time the library will be simply a storehouse for books, with no opportunity for students to consult them at tables. This need for space is independent of any further growth of the number of students in the department. The library should be enlarged to take in the whole front of Engineering A, and this would require that we be given a large drawing-room elsewhere capable of accommodating from seventy to eighty students. We also need a large lecture-room, where large classes can be addressed in subjects which do not require division into sections.

2. We need more teachers in the higher grades. I have already called attention to the fact that we need an assistant professor of hydraulic engineering, to relieve Professor Porter of some of his work and to make it possible to give advanced instruction, if it is called for. Further, in railroad engineering and in surveying the classes are growing so rapidly that we need some additional teachers at least of the grade of instructors.

On account of the fact that the teaching staff is so burdened with the regular work of the school, we are able to offer but little graduate work, and none whatever in some branches; and, although we have frequent application from men who wish to come here to take advanced work, we have frequently been obliged to say that we could not offer them certain courses.

3. We could spend more money each year to advantage in improving and enlarging our equipment, both for field instruction and for apparatus in the hydraulic laboratory. I should also be very glad to be able to increase our collection of photographs and slides, and to feel free to engage more outside lecturers if opportunity should offer; and, in various ways, to strengthen and add to the resources of the department. With larger classes, the field equipment is becoming inadequate.

4. I wish very much that our salaries were more in proportion to what a man of ability might earn in the practice of his profession. It is difficult to induce our best graduates to take up teaching, because there are so many attractive opportunities outside. We have many applications each year for young men to teach in other schools, but the salaries are so meagre that they do not tempt the good men. The same thing is true to a certain extent of the Institute, although we generally succeed in persuading some of our graduates to remain a year or so as assistants. During the past summer there were eight applications for teachers, of which we were able to fill only two.

The course of study in civil engineering has been modified for the present year, preliminary to the changes which follow the increased entrance requirements in modern languages. The field of civil engineering is so broad that it is necessary to teach our students a great number of very different subjects, and indeed it frequently seems as if we were endeavoring to cover too much ground. As a matter of fact some other institutions cover as much ground in professional subjects as we do, or more, although they do not require the students to devote so much time to general and linguistic studies. Our students are working all the time under very high pressure, and they are also obliged to turn so rapidly from one subject to another that they find it difficult to concentrate sufficiently to master any one thoroughly. To remedy this, several of the short courses have been omitted, and it is desired in the future to consolidate some of the remaining courses, so that they may be more consecutive and more effective. It would be very desirable if some means could be found for diminishing still further the number of separate courses and examinations which our students are required to take, and if they could be taken up more consecutively rather than simultaneously, in a manner similar to that which is pursued at the Harvard Medical School. No practicable way, however, has yet been suggested for accomplishing the latter object.

In Course XI. some rearrangements and omissions have been made of a similar nature to those which have been made in Course I., and further rearrangement will follow.

The department is convinced of the necessity of having the curriculum arranged so that dependent studies shall be continuous. If one course depends upon a previous one, it should follow it immediately, and every effort should be made to prevent waste and duplication. The arrangement of the courses in Civil Engineering and Sanitary Engineering is and always has been somewhat defective in these respects, but it has not been practicable to improve it. The opportunity now offered for a rearrangement of these courses, consequent upon the advance in entrance requirements in languages, has suggested the advisability of a somewhat radical modification of the curricula. The teaching force of the department believes that such a radical modification, if it can be accomplished, will be accompanied by a great increase in efficiency.

Professor Allen has taken part in the preparation of a report by a committee of the American Railway Engineering and Maintenance of Way Association, and I have had occasion to co-operate in the preparation of similar reports of committees of the American Society of Civil Engineers, the Association for Testing Materials, and the Railway Engineering and Maintenance of Way Association.

The usual Summer School in Civil Engineering was omitted in the year 1904, partly on account of the small number of applicants. This may have been due in part to the business depression and in part to the fact that the third-year men who desired to take the course had taken it the previous summer, while the second-year men preferred to wait until another year. The school will probably be held in 1905.

GEORGE F. SWAIN.

DEPARTMENTS OF MECHANICAL ENGINEERING AND APPLIED MECHANICS.

The number of students to whom instruction is given in the Departments of Mechanical Engineering and Applied Mechanics is even greater than it was last year. In applied mechanics, instruction is given to five hundred and thirty-five, while the number receiving instruction in mechanical engineering subjects is seven hundred and thirty-six.

In last year's report the following statements were made, viz.: —

"In order to keep up with the times, we are in great need of a very considerable amount of additional apparatus, not only to enable us to pursue investigations along new lines of very great importance from an engineering standpoint, but also to provide for our regular laboratory classes the amount of instruction required."

"The above stated needs have been yearly explained in detail in the recommendations made to the Budget Committee, and it is hoped that the Executive Committee may soon see its way clear to supply them."

These statements apply with equal force this year.

We are constantly carrying on investigations, partly by means of thesis work, and partly by means of the regular laboratory work, and many of them are of great importance from an engineering point of view. While a number of examples of such investigations were mentioned last year, only a few will be referred to here.

1. The problem of the strength and other resisting properties of re-enforced concrete is of such general interest to-day that a joint committee, to make a study of this subject, has been formed from four societies, viz.: the American Society of Civil Engineers, the Engineers of Maintenance of Way, the American Society for Testing Materials, and the Cement Manufacturers.

We have been, and are still, making investigations along these lines, and the fact that I am a member of the committee, and the representa-

tive of the American Society for Testing Materials on the joint committee on Plan and Scope, will aid in establishing a co-operation between our work and that of others.

2. Among the investigations in which we are engaged are several of considerable importance to the locomotive builder, and to the motive power department of railroads, which have been undertaken by us because they are live questions, calling for experimental study. Among these may be mentioned the strength and other resisting properties of connecting rods, the strength of locomotive springs, etc.

3. A series of tests has been made of the 1400 horse-power Curtis Steam Turbine plant of the Nashua Light, Heat and Power Co., at Nashua, N.H.

4. A series of tests has been made of an independently fired superheater to determine its efficiency, etc.

5. Measurements have been made of the flow of superheated steam by means of orifices.

In the instruction in mechanism, printed notes have been used heretofore, but Professors Schwamb and Merrill have just published a treatise on mechanism, which will be of great advantage in connection with the instruction in this subject.

The Department of Applied Mechanics has suffered a severe loss in the death, during the past summer, of Professor Jerome Sondericker, who had been with us since 1885.

The work heretofore performed by him has been divided between Professors Fuller and Johnston, while to Mr. H. W. Hayward has been assigned a portion of the work hitherto performed by them. The duties heretofore performed by Mr. Hayward have been assigned to others, and a sufficient number of additional assistants has been employed to carry on their work.

All the graduates of 1903–04 have found employment.

GAETANO LANZA.

DEPARTMENT OF MINING ENGINEERING AND METALLURGY.

The changes to be noted in the apparatus of the department are chiefly those required for taking care of the increased number of students. To these must be added the replacement of a worn-out machine by a new one.

The Ore-dressing Laboratory has received a pair of 12 x 12 belt-driven rolls, made by Allis Chalmers Company, mounted with friction clutches to throw them into gear with the power. It also has a complete new set of screens to be used with these rolls, carefully computed according to Rittinger's scale of sizes. An addition made last year, but not noted in the President's Report, is a new system of tanks to be used with the concentrating machinery, eight of them in all. They are supplied with centrifugal pumps, so that the water can make the circuit, doing its work of concentration on the machines, and returning to the tank to be cleared of fine mud by settling, preparatory to being used again. These tanks are mounted in duplicate, so that, if one tank is charged with the run of yesterday, there is another one ready to make a test to-day.

In the Metallurgical Laboratory, including that used for instruction in heat and metallography, there have been added two resistance heating furnaces and two rheostats.

In the Assaying Laboratory four Becker pulp balances and two Keller button balances have been added.

To increase the efficiency of the reports of the week's work, a neostyle has been supplied for preparing the week's report and placing it in the hands of the students.

On account of the additional demand upon his time in analytical chemistry, Dr. Fay has been obliged to give up the work in metallography, and Professor Sauveur of the Lawrence Scientific School, Harvard University, has undertaken it.

The summer school this year was carried out on new lines, with the title the "George Crocker Summer School of Mining Engineering," and was made possible by the generous gift of $12,000 made by Mr. Crocker. It was attended by students from Columbia University, Harvard University, the Massachusetts Institute of Technology, and Yale University. The students of the Colorado School of Mines were also invited to take part. Mining and milling were studied at Silver Plume and Idaho Springs, and placer work at Breckinridge, Colorado. Six weeks were spent in this line of work; at the end of this period the students of the Institute made a metallurgical trip of one week to visit the smelters and cyanide plants of Denver, Colorado Springs, Cripple Creek, Cañon City, Florence, and Pueblo. The reports from the students and also from the instructors show the summer school to have been a great success.

To do its present work to the best advantage, the Mining Department needs double its present floor space. If it is to expand to advantage, it needs three times the space. From present appearances, we shall probably be able to care for the students this year and next year in the assaying department. We shall, however, have every desk and locker occupied. Metallography is especially cramped, as its only domicile is the two tables in the middle of the museum. The space in the museum has also been called upon for some of the assaying balances.

Professor Richards has completed a new note-book for the third-year mining engineering of the first term, and is now preparing one for the second term. The note-book that was contemplated for the second-term mining engineering of the fourth year is postponed by the offer of Professor Miller to take that class of students.

Professor Hofman's new Notes on the Metallurgy of Iron are ready for use with the present class. They are revised and brought up to date.

Professor Lodge has prepared a new note-book on assaying,

together with a portion of the fourth-year laboratory work. This note-book includes a résumé of the investigations made by students in their theses for the past ten years or more, and is a valuable contribution to the subject. The library has received the missing numbers of the *Comptes Rendus Mensuels*, Société de l'Industrie Minérale; the series begins at the year 1847.

Assistant W. P. Davis has classified and listed the drawings and blue prints of the department, making them handier for use.

The museum has received from Mr. A. L. Davis a fine set of samples of crucible steel, showing fractures of different per cents. of carbon and changes in color and structure in process of annealing.

Professor Richards presented a paper on "The Relation of Mining Engineering to Other Fields," before the International Congress of Arts and Sciences at St. Louis.

ROBERT H. RICHARDS.

DEPARTMENT OF ARCHITECTURE.

Last year was a very successful one for the department. A strong graduate class set the pace to which the undergraduate class finely responded. It was possible to send two exhibits of architectural work to St. Louis, one of which was to represent the Institute as a Land Grant College. In addition to this, the regular exhibition at the end of the term was the best we ever had.

The good influence of the graduate class makes us desire more and more to have the third- and fourth-year classes brought in direct contact with it and its instructors, and to this end we hope that it will be possible to have such necessary changes made in the drawing-rooms as we asked for last year.

The Rotch Prize of $200 for the regular student making

the best record during the four years was given to Miss Eliza Codd, and the one of $200 to the special student doing the best work during two years was equally divided between Mr. L. Schwartz and Mr. A. P. Wadsworth. The Boston Society of Architects also gave two prizes of the value of $50 each in books, one to Mr. O. M. Wiard and one to Mr. H. S. Pitts. These prizes were given for skill in design; the problem being approved by the Society, and ability in solving it decided by a jury of its members.

Mr. G. C. Glover, the first recipient of the Perkins Graduate Scholarship, has recently returned from Europe. His year has been very successful, and a proof of the excellence of his work is shown by its admission to the Paris Salon. Mr. G. B. Ford, who is aided in his studies by the Swett Fellowship, is still in Europe devoting his time mainly to the Ecole des Beaux-Arts at Paris, of which he is a member. Both these young men have met with most gratifying results the responsibility placed upon them, and we sincerely hope that other fellowships may fall to the department for the good of our graduate class.

The fourth-year class of last year showed a just appreciation of the opportunities they had profited by, by establishing a prize for third-year work. The spirit which prompted this act is best shown in their own words. "In consideration of the great benefit to the students of the fourth year resulting from the prizes offered by the Boston Society of Architects, the members of the Class of 1904, desiring to have similar opportunities offered to students of the third year, do hereby pledge themselves to contribute one dollar annually towards the foundation of a fund to be known as the 'Class of 1904 Competition Prize.' From the capital of this fund are to be given two prizes of the value of ten dollars each to the regular and special students whose designs shall be placed first in a competition to be held between the Christmas and the Mid-year recesses."

This year has opened with every table occupied, and with a

large number of college graduates. An interesting feature is that the college-bred man is more desirous of adding the Institute degree to the one he already possesses, or, if he prefers to rest as a "special," he is not so likely to limit himself to the æsthetic side of his profession as formerly, but, in the interest of scientific construction, adds the necessary mathematics to his course. It has been found that the courses at the Paris Beaux-Arts, if the student is to take his degree there, are somewhat more exacting than at the Institute. This has had its good influence here, as shown by the above results. Another cause of this change is undoubtedly the steadily increasing demand for engineering knowledge in all important work; but the fact remains that the association of construction and design is coming to receive its proper recognition.

FRANCIS W. CHANDLER.

DEPARTMENTS OF CHEMISTRY AND CHEMICAL ENGINEERING.

In the withdrawal of Professors Willis R. Whitney and James F. Norris from active participation in its work, the department has lost the services of two of the most valued members of its instructing staff, whether regarded as able investigators in their chosen fields, or as inspiring teachers. Professor Whitney will devote his entire time to the direction of the research laboratories of the General Electric Company at Schenectady, retaining, however, a connection with the department as Non-resident Associate Professor, while Professor Norris has accepted a professorship in chemistry at Simmons College and is in charge of that department of the college work.

The Chemical Department is, however, fortunate in having other instructors at hand who were able and willing to take up the work which Professors Whitney and Norris have laid

down, and who will endeavor to carry it on in the same helpful spirit that has heretofore prevailed. The instruction in theoretical chemistry, formerly in Dr. Whitney's charge, is now given in part by Professor Noyes, in part by Dr. John W. Brown, and in part by Professor Goodwin of the Department of Physics, while the Laboratory of Organic Chemistry and the lecture courses which were formerly under Dr. Norris' care are now intrusted to Professor F. Jewett Moore. This transfer has, in turn, made necessary a re-arrangement of the instructing force in analytical chemistry, by which Professor Fay assumes charge of the entire work in this branch of the department, except that given to first-year students, and, to this end, is relieved from his work in metallography and is given additional assistance. An arrangement of this character is particularly desirable at this time, in view of the many problems presented by the changes in the Course in Mining Engineering, as a result of which the work of students in this Course must undergo extensive revision; and the effect is also likely to be indirectly beneficial with respect to the work of all students in analytical chemistry. This much-desired introduction of this subject into the second year of the Course in Mining Engineering makes it necessary to accommodate about forty additional students in the analytical laboratories. This it has been possible to do for the present year, owing to an apparent slight decrease in the number of students of the second-year class who have elected Courses which include chemical work beyond the first year. Of a total of two hundred and twenty-nine desks, about ten are now unoccupied.

With the opening of the present year there has been a marked and gratifying increase in the number of graduate students in chemistry. These now number eight, of whom seven are now candidates for the degree of Doctor of Philosophy and the other expects to become a candidate for this degree. Of these, five expect to work mainly in physical chemistry, two in inorganic chemistry, and one in organic chemistry. It has been necessary to equip an additional

laboratory in Engineering C for the use of some of these men, a part of whom also find quarters in the Research Laboratories of Physical Chemistry. It is undoubtedly due to the establishment of the Research Laboratory under the direction of Professor Noyes that this graduate work has been stimulated and it should also be stated that the helpful and inspiring influence of this laboratory is manifest in many ways among the members of the instructing staff of the Chemical Department, especially among its junior members.

The Summer School of Industrial Chemistry, under the direction of Professor Thorp, was attended by twelve students, and lasted from the ninth to the twenty-fifth of June, during a part of which period Professor Walker also accompanied the party. In all twenty-eight plants were visited, as follows: —

Arnold Print Works, North Adams, Mass.; Stamford Chemical Co., Stamford, Vt.; West Virginia Pulp & Paper Co., Mechanicville, N.Y.; American Hide & Leather Co., Ballston, N.Y.; International Paper Co., Glens Falls, N.Y.; Union Bag & Paper Co., Fenimore, N.Y.; Salt Springs Solar Salt Co., Syracuse, N.Y.; Crucible Steel Co., Syracuse, N.Y.; Straight Line Engine Works, Syracuse, N.Y.; Onondaga Pottery Co., Syracuse, N.Y.; Empire Portland Cement Co., Warners, N.Y.; Vacuum Oil Co., Olean and Rochester, N.Y.; Worcester Salt Co., Silver Springs, N.Y.; Rochester Glass Works, Eastman Kodak Co., Curtice Brothers, Bartholomay Brewing Co., and Pfaudler Co., (Enameled Steel Tanks) at Rochester, N.Y.; National Battery Co., Lackawanna Steel Co., Larkin Soap Co., Buffalo Pottery Co., Buffalo Smelting Works, Standard Oil Co. (Atlas Works), Pratt & Lambert Co., at Buffalo, N.Y.; Natural Food Co., Niagara Falls Power Co., and Niagara Falls Research Laboratory at Niagara Falls, N.Y.

Every effort was made by those in charge of these plants to promote the interests of our students and in a number of instances luncheons and mementoes of the trip were provided for the entire party. Special courtesies were also extended

by the Institute graduates who are located at the works of the Eastman Kodak Co. As in former years, evening conferences for the comparison of notes and general discussion were an important feature of the instruction. These usually lasted about two hours, and the interest in them was well sustained throughout. The school may be regarded as eminently successful, and the written reports (or abstracts of them), which are also required from each student who took part in the trip, will be placed in the Chemical Library.

The division of the first-year class into two sections with reference to their previous experience in chemistry, referred to last year, has proved to be of as great advantage as was then anticipated, and the tentative effort of last year is being developed into a carefully studied plan which involves a revision of the laboratory work assigned to both sections under the charge of Professor Bardwell, who took up this work this fall after a year's absence for study at Leipsic University.

The changes in the courses of instruction in Chemistry and in Chemical Engineering during the past year have been few. In the former the time devoted to analytic geometry of the first year has been extended, with the consequent omission of the instruction in wood and metal turning, and in the senior year of the Chemical Engineering Course the lecture course in theoretical chemistry has been made a required subject. The demand for graduates from both of these Courses is gratifying in its constancy and has been considerably in excess of the supply for a number of years. This is notably true of the year just past.

The need for more adequate accommodations for the work of the department is more keenly felt each year. Not only are certain branches of the instruction suffering from the congested state of the laboratories allotted to them, but the department as a whole is lessened in efficiency because of the isolation of portions of its work in separate buildings (four in all), away from the Chemical Library and the sources of

supplies, and so widely distributed that community of interest among the members of the department working in different lines is seriously diminished.

A re-united department in a building designed for the purpose of chemical instruction, with the much-needed supply of small laboratories for research, advanced, or special work, is imperatively needed to permit of the development of the departmental work which has been for some years, and is still, prohibited by the impossibility of attempting more in the space at command.

H. P. TALBOT.

RESEARCH LABORATORY OF PHYSICAL CHEMISTRY.

The Research Laboratory has suffered a severe loss in its professorial staff by the withdrawal of Dr. W. R. Whitney from active participation in its work. It has, however, been greatly strengthened on this side by the appointment as Assistant Professor of Physico-Chemical Research of Dr. W. D. Coolidge, to whose co-operation in the equipment and direction of the laboratory and in the supervision of researches the success attained during the past year is in large measure due. Professor H. M. Goodwin continues to take charge of the researches carried out with the help of the grant from the William E. Hale fund. The research staff consists, in addition, of seven research associates and assistants who are devoting their time almost exclusively to original investigations. Among these are graduates of the Institute, of Yale and De Pauw Universities, and of the Universities of Leipsic, Kioto, and California.

Upon the financial side the laboratory has been again assisted by a grant of $1,000 from the William E. Hale Research Fund and by a renewal of the grant of $2,000 from the Carnegie Institution to Professor A. A. Noyes in aid of certain electrochemical investigations which are being carried on in the laboratory. From Mr. Samuel Cabot, too, who

has assisted the Institute in so many other directions, a substantial contribution has been received. The laboratory is also indebted to Captain E. L. Zalinski for a generous gift by means of which the lighting system has been provided with prismatic reflectors.

Up to the present time six contributions to scientific journals, describing the researches made in the laboratory since its establishment in September, 1903, have been published. A list of these, as well as of the other publications of members of the research staff, is included elsewhere. The investigations, referred to in the Report of last year, upon the conductivity of aqueous solutions at high temperatures, upon the conductivity of fused salts, and upon the migration of colloids are being continued by Professor W. D. Coolidge, Mr. A. C. Melcher, and Mr. Y. Kato, by Mr. R. D. Mailey, and by Dr. J. C. Blake, respectively. Researches have been begun upon the solubility of salts in water at high temperatures b3 Mr. R. B. Sosman, upon the dissociation-relations of phosphoric acid by Mr. G. A. Abbott, upon the heat of solution of substances in relation to the ionic theory by Mr. W. H. Whitcomb, upon the properties of liquid ammonia solutions by Mr. C. A. Kraus, and upon the rate of decomposition of minerals by water by Dr. W. Böttger.

Especially worthy of mention seems the fact that the establishment of the Research Laboratory has led a considerable number of graduate students to undertake advanced study at the Institute in the subjects of physical and inorganic chemistry. There are at the present time eight candidates pursuing in the laboratory such courses of study for the degree of Doctor of Philosophy. It is to be hoped that this may be the beginning of a new development of advanced work at the Institute, and that it may soon be possible to start similar research laboratories devoted to other branches of science, especially to the other divisions of physics and chemistry. Such laboratories cannot fail to react in an important way on the character of our undergraduate instruction and on the scientific spirit of our students.

An important feature of the work of the laboratory is the advanced instruction given in connection with it. This consists for the most part of seminar meetings and lecture courses devoted to special topics of physical chemistry, which are varied from year to year. This year the courses embrace the subjects of chemical equilibrium, radio-activity, solid solutions, metals and alloys, photochemistry, and the constitution of inorganic substances in solution. The last-named course is to be given in German by Dr. W. Böttger during the coming term. Instruction on the manipulative side, consisting in a course in glass-blowing under the charge of Mr. C. A. Kraus, is also provided. Once a week, too, all workers in the laboratory meet to discuss the researches in progress there and the recent periodical literature.

A. A. NOYES.

DEPARTMENT OF ELECTRICAL ENGINEERING.

The development of the Electrical Engineering Laboratory during this past year has been such as to bring the instruction into much closer touch with the lectures in theoretical electricity, the experiments being planned to bring out fundamental principles, rather than to be mere tests of efficiency or regulation of electrical apparatus. The new system of laboratory instruction with preliminary reports and conferences is giving most gratifying results, the students showing a marked gain in independence and in understanding of the work. This year for the first time an entire term in the laboratory is devoted to alternating current work.

Considerable use has been made of the power plant for purposes of instruction, including a set of five tests upon the 480-kilowatt unit, with cooling tower, condensing plant, and all auxiliaries necessary to its complete operation as a generating station. The object and results of these tests were thoroughly discussed in the class-room. This present year it is purposed to give the junior students in this department the

major portion of their instruction in mechanical engineering laboratory work in our own power plant. There has been planned a system of excursions, under the supervision of the department, to various electric lighting and power plants of different types situated in Boston and vicinity, and, in connection with these, formal reports are to be presented by the students and discussed in consultation with them.

Many of the senior students have already planned their theses and in some cases the work is well under way. This early determination of thesis subjects, with the possibility of a more careful consideration of the matter for investigation, will be a distinct advantage in the work along these lines.

The Standardizing Laboratory is called upon, not only for the regular work of instruction, but also to provide facilities for the calibration of many instruments used in thesis work in the Electrical Engineering Department and in other departments of the Institute. For direct current work the laboratory is well supplied with apparatus, but for certain alternating current calibrations additions to the equipment are greatly needed. These additions would result in economy of time to those students engaged in thesis work and would enable them to devote their energies to the problems in hand, rather than to the preparation for attacking them.

The facilities of this laboratory are freely offered to other departments of the Institute, and during the past year the Departments of Physics, of Physico-Chemical Research, of Mechanical Engineering, and of Naval Architecture have availed themselves of the privilege. The increasing number of tests involving electrical measurements made by students in mechanical engineering will probably cause this part of the work to assume great importance in the near future.

Considerable attention is given to special devices needed in thesis work. During the past year several recording instruments which served their purposes have been designed, and much time has been devoted to the development of the oscillograph. Experience has demonstrated that the Duddell form

of instrument is unsuited to general laboratory use, on account of its mechanical delicacy and the consequent delay and expense incident to repairs. The form of instrument which has been developed in the department is simple in its mechanical arrangements, the parts are so accessible that repairs are readily made, and the instrument is now one which can be put in the hands of students for regular work.

The Augustus Lowell Laboratories are called on to furnish facilities for many students in other departments of the Institute, there being this year seventy-five students in mining and mechanical engineering who are carrying on optional laboratory work in connection with the course in dynamo electric machinery. This class of students from other departments promises to increase in numbers in the immediate future, and to give them proper instruction it will be necessary to have additional assistance in the laboratory. It is also highly desirable to introduce a greater amount of recitation work than at present exists in connection with some of the lecture courses, and this also will necessitate an increase in the instructing staff of the department. We are in need of two small recitation rooms for our own use exclusively, to be devoted to laboratory conferences and journal meetings. These come at irregular times and cannot, therefore, be planned for definitely at the beginning of each term.

This department is at present assisting the Departments of Mechanical Engineering and Naval Architecture in connection with certain electrical work involved in the proper carrying out of thesis investigations. It will also be called upon this present year to furnish evening instruction to about thirty men belonging to the Lowell Institute School for Industrial Foremen.

Arrangements have been completed for supplying power to the Department of Physics for use in the Laboratories both of Heat Measurement, and of Physical Chemistry. It is interesting to note the demands made by the Walker and Rogers Buildings upon the power plant. Previous to the

completion of this plant, the maximum load of these two buildings was a little less than one hundred kilowatts, including the demand for laboratory work then carried out in the basement of the Walker Building. Since the taking of the entire electrical load by the plant of the Electrical Engineering Department, the maximum demand for these buildings has shown an increase of more than ten per cent. When the equipment now in process of installation comes into use, there will be a still further increase. The present total output of the power plant is about three hundred and ten kilowatts.

During the summer there have been designed and built in the department transformers illustrating the various features of polyphase systems, as well as showing the effect on efficiency and regulation of varying amounts of iron and copper. These transformers are to be used for regular work in the laboratory. A number of alternating current measuring instruments has been added to the equipment, but the supply at present available for purposes of laboratory instruction is inadequate fully to meet the demands. A room has recently been fitted up for an instrument room and a card catalogue of all instruments in the department has been begun. An automatic voltage regulator for maintaining constant potential of distribution has been designed in the department and is soon to be installed. There has also been added a number of lecture-room models and of working diagrams.

It would be of the greatest benefit, both from the standpoint of investigation and also for regular work in the laboratory, if a storage battery of fairly large capacity could be installed in the Lowell Building. This would obviate the necessity for drawing current from the Edison system, with its consequent expense, and with the care which the battery would receive in the department the depreciation should be extremely small.

The pressing needs of the department are then: additional instructors; additional rooms for recitation work; additional

equipment in units of small capacity; additional equipment in measuring instruments; and a storage battery of large capacity.

H. E. CLIFFORD.

DEPARTMENT OF BIOLOGY.

The routine work of the Department of Biology has gone forward smoothly and successfully. Two new courses of instruction have been introduced, namely, one in municipal laboratory methods and one in plant physiology, both in the fourth year. There have sprung up in connection with numerous state and municipal Boards of Health within the last few years laboratories for the chemical and bacterial examination of materials sent in by physicians, for the analysis of water, ice, sewage, milk and the like; for the examination of wall papers for arsenic; and for general usefulness in connection with the practical work of active Boards of Health. Several of our graduates having found useful positions in connection with such laboratories, we have introduced a new course of instruction covering as far as possible the principles and subjects likely to be dealt with in the future by such laboratories. The responsibility for the course has been assigned to Mr. Winslow, Instructor in Sanitary Biology, who is now teaching in the subject a class of four seniors and one graduate student. The course in plant physiology is designed to supplement and broaden that in animal physiology and is given this year by Professor Sedgwick, but will hereafter be taught by Dr. Stiles, who has charge of the lectures and laboratory work in animal physiology.

A much-needed and most welcome gift of six high-power microscopes was made to the department during the year by Dr. Charles G. Weld, and the microscopes have been in almost constant use, ever since their arrival, in our bacteriological and zymological teaching and in advanced work.

The several members of the staff of the department have

been diligently occupied, in addition to their teaching, in scientific or public work in various directions. Professor Sedgwick finished in May his testimony in the Chicago–St. Louis Drainage Canal case, and spent the summer in completing the work upon physiology and hygiene which, in collaboration with Professor Hough formerly of the Department, he has for some time had under way. He was in September one of the two appointed speakers in the Public Health Section of the International Congress of Arts and Science of the Louisiana Purchase Exposition, his subject being "The Relation of Public Health Science to Other Sciences."

Professor Prescott has prosecuted and carried nearly to completion an interesting and important research upon the efficiency of commercial milk pasteurizers,— machines intended for the purification of the milk supply of cities,— especially as regards their efficiency in the destruction of putrefactive and pathogenic micro-organisms. He has also continued his investigations in the technique of the canning industry,— this time studying canned tomatoes,— and has also given some attention to the micro-organisms involved in the production of champagne, and in some processes of the tanning of leather. Together with Mr. Winslow, Instructor in Sanitary Biology, he has published a small but much-needed work on the Bacteriological Examination of Water.

Mr. Winslow, in addition to his duties as instructor, and as Biologist in Charge of the Sanitary Research Laboratory and Sewage Experiment Station, has found time not only to complete the volume just referred to, but also to prepare a work upon applied microscopy for the use of our classes,— chiefly chemists and biologists,— in that subject in the second year. It is hoped that this may be ready for the class during the present session.

Mr. W. Lyman Underwood, Lecturer on Sanitary Biology, who is also Chairman of the Board of Health of Belmont, published in June, 1903, at his own expense a valuable pamphlet on the mosquito nuisance, for the Board of Health of

Belmont. This pamphlet, strikingly illustrated with photographs made by Mr. Underwood, was also published with some modifications in the *Popular Science Monthly* in the autumn of the same year. Not long afterward a request was received from the General Board of Health of Bermuda for a large number of copies of the pamphlet. In compliance with this request Mr. Underwood, after bringing the subject up to date, prepared and sent to Bermuda for the use of the Bermuda Board of Health a large special edition of the pamphlet.

Messrs. Winslow and Underwood have been much engaged during the year in an extensive investigation of the sanitary conditions of the Fresh Pond and Mystic River Marshes at the request, and on behalf of, the Metropolitan Park Commission, and have already reached interesting and valuable conclusions, which will soon be published.

Dr. Arthur W. Weysse, Instructor in Zoölogy, has completed and published a large and important text-book on General Zoölogy, based upon the course of instruction in that subject given by himself for several years past in our department. Toward the end of the college year Dr. Weysse was appointed Assistant Professor of Biology in Boston University, and in consequence has been obliged to give up a large part of his teaching at the Institute. Dr. Frederick A. Woods, formerly a student in the Biological Department, has been secured to take charge for the current year of some of the classes hitherto taught by Dr. Weysse.

The physical conditions of the Department are now, on the whole, good. There are needed, however, (1) a special room for Professor Prescott's investigations in Industrial Biology. For these the research laboratory is inadequate, as considerable space is required for elaborate apparatus and for experiments on a large and practical scale. It is greatly to be desired that Room 20, Engineering B, should be assigned to us for this purpose. (2) We need also a number of microscopes specially provided with micro-spectroscopes and micro-

polariscopes for the use of the class in applied microscopy. (3) We ought to have an entirely new outfit of microscopes for the classes in general biology. A number of our microscopes are not of modern construction and have been in use for many years. Much time and labor might be saved to the students by supplying them with the latest and best working instruments.

W. T. SEDGWICK.

THE SANITARY RESEARCH LABORATORY AND SEWAGE EXPERIMENT STATION.

The work of the Laboratory and Experiment Station, located at No. 786 Albany Street and maintained by the generous benefaction of a donor who desires to remain anonymous, has been actively prosecuted during the year as nearly as possible along the lines indicated by the donor in his deed of gift. The station was equipped during the spring of 1903, and in June of that year work was begun. The present report, therefore, covers the first complete year of work, and is necessarily a report of progress.

As an indispensable preliminary investigation, and the basis of other work, we have carried out an exhaustive study of the chemical and bacteriological composition of the sewage of the South Metropolitan District with special reference to hourly and diurnal variations. This constitutes, we believe, the most thorough study of the composition of the sewage of a great seaboard city which has yet been made anywhere, and prepares the way for a searching examination of the processes of disposal by dilution now employed in the disposal of the sewage of both the North and the South Metropolitan Districts, in Boston Harbor. It will soon be published.

Experiments on a practical scale have also been carried on upon the various methods of sewage purification at present favorably known to engineering science, including intermittent sand-filtration; septic-tank treatment; contact-filtration; and

continuous sand-filtration,— otherwise known as the method of "trickling" filters. Inasmuch as the time element is of fundamental importance in experiments of this character,— the slow clogging of filters under prolonged operation being one of the most serious problems with which municipalities embarking practically upon any one of these methods have to deal,— no conclusions can be drawn at this time as to the final merits of these different methods.

Early in 1904 it became necessary, in view of the experience thus far accumulated, to enlarge the experimental plant, but since that time all experiments have been carried out on parallel and continuous lines. It is now hoped to prepare a full report at the end of another year, although the two years of continuous operation which will then have elapsed are too short a period for securing the best results. Research laboratories and experiment stations of this kind gain in value in increasing measure with time and experience, and the most valuable results can be expected only after years of accumulated experimentation and study. It is intended, nevertheless, to bring together all the results at the end of another year and to publish at that time a full report of the work thus far accomplished as well as a review of all other work and experience in sewage purification, both in this country and abroad. By thus compiling and co-ordinating the results of our own experiments and those of others, all over the world, it is believed that the fundamental principles of sewage purification can be worked out and exhibited far more satisfactorily and in a more practically useful manner than ever before.

A detailed study of the chemical methods of sewage analysis has already been completed by Mr. E. B. Phelps, Research Chemist and Bacteriologist at the Station, with the result of a clarifying of current ideas and a simplification and standardization of methods used. Bacteriological investigations have also been made which throw much light upon the bacteriology of crude and purified sewage, and a new method for the direct microscopical enumeration of bacteria has been developed by

Mr. Winslow, the biologist-in-charge. Two original papers on the methods and results of chemical analysis of sewage, two on the bacteriology of sewage, and one on the chemical changes taking place in the contact sewage filter, are either already published or nearly ready for publication.

In accordance with the expressed wish of the donor, the publication of leaflets more or less closely connected with matters of sewage and sewage disposal has been begun in a series of popular essays entitled "Dirt and Disease." Of these essays three, in the form of simple leaflets, have already been published, namely, No. 1, "Why Dirt is Dangerous," No. 2, "Why Dirty Milk is Dangerous," No. 3, "Why Dirty Water [including sewage] is Dangerous." These leaflets have thus far been prepared by the Director and have had as their place of original publication the pages of the *Journal of the Massachusetts Association of Boards of Health.* They have already had a considerable circulation among Boards of Health, milk contractors, public school authorities, etc., and the demand for them is steadily increasing.

A few minor sewage problems, for one reason or another especially urgent or instructive, have also been attacked at the station, with results more or less satisfactory, namely, the treatment of waste from a glue factory; the treatment of sewage rich in strawboard waste; and the purification of sewage from isolated country houses of large size.

The station has been repeatedly visited by classes from the Institute and other institutions, and has also abundantly proved its practical value for thesis and other investigations by Institute students and workers in sanitary biology, sanitary engineering, and sanitary chemistry.

Our thanks are especially due for numerous and repeated courtesies, and for much valuable assistance, to Mr. Edgar S. Dorr, M. I. T. '75, Chief Engineer of the Sewer Division of the City of Boston, and also to Leonard Metcalf, M. I. T. '92, for the design of a grit chamber for our main sewage intake-pipe.

W. T. SEDGWICK, *Director.*

DEPARTMENT OF PHYSICS.

The rapid increase in the number of students attending the lectures in general physics has caused serious and increasing difficulty for a number of years past; and this not only on account of the limited capacity of our largest lecture-room, but also for the reason that it is not conducive to the most efficient instruction to have over a certain number in attendance at one time. With a course as thorough as our own, it is important that every student should be able readily to hear everything that is said and to see every experiment without difficulty. Matters were brought to a crisis by the unprecedented size of the second-year class in 1903–04, and the difficulty was met in the only possible manner, as had been done a number of years ago in the case of the lectures upon chemistry to the first-year students. The class was divided into two sections, and lectures were given to these upon alternate days. One section was placed in charge of Dr. Wendell, while the writer took charge of the other. The results have proved entirely satisfactory, and it has been a great relief to have only to deal with sections of such size as can be comfortably seated in the lecture-room.

The transference of Professor Clifford to the Department of Electrical Engineering made it impossible for him longer to continue to deliver to the third-year class the course of lectures on heat which he had given successfully for a number of years. They were, therefore, transferred to Professor Norton, an arrangement especially appropriate, as his position in charge of the Laboratory of Heat Measurements allows of a closer connection between the lectures and subsequent laboratory work than would easily be secured under other circumstances.

During the past year the number of students taking work in the Physical Laboratory has been the largest in the history of the school. In the first term instruction was given to two

hundred and ninety-six students per week and in the second term to three hundred and five. To meet the increase, two steps were imperative: first, a very considerable duplication of apparatus, and, second, a material increase in the number of laboratory sections. In order that the number of students should not exceed twenty in each section, a number which experience has shown to be the maximum for efficient instruction, it was found necessary to lengthen the working hours, so that the laboratory is now open continuously during school hours from 9 A.M. Monday until 1 P.M. Saturday.

With a somewhat increased staff of assistants it has been found possible to keep the apparatus in proper repair and to maintain the usual ratio of instructors to students, namely one instructor and one assistant to each section of not over twenty students. The days of small sections and close personal relations between instructor and student have now unfortunately passed for the large general courses.

It will be seen that we have practically reached the limit of the capacity of the present Laboratory of General Physics, as a further increase of size of sections, even with a proportional increase in the number of instructors and assistants, will unquestionably result in less satisfactory work. Good physical manipulation cannot be performed under crowded conditions with the resulting general confusion. To meet, therefore, any further material increase in the size of our classes, the laboratory equipment will have to be duplicated and installed in separate rooms, so that independent sections can be accommodated simultaneously.

An innovation in the instruction has been tried with marked success during the past year, and will be continued the present year. The new laboratory notes by Dr. Goodwin have been issued in two parts, (1) the introductory work on General Physical Measurements and Mechanics, and (2) the more difficult work on Heat. The students are at first allowed to refer to their notes in the laboratory until they become familiar with the more fundamental

instruments and methods, but in the latter part of the course no notes are allowed in the laboratory, all preparation for the work being done previous to the exercise. In carrying out their experiments the students are thus led to rely more and more upon themselves and their acquired knowledge rather than upon printed directions, and insufficient preparation becomes quickly evident.

The enormous labor involved in the critical examination of between 4,000 and 5,000 laboratory reports in the year has been most conscientiously performed by Mr. Drisko, whose individual conferences with the students on these reports and their work form one of the most valuable features of the instruction.

To bring the students into closer contact with the instructors, and to emphasize even more than in the past the value of precision discussions in connection with all experimental work, the lecture course on physical measurements and precision of measurements which accompanies the laboratory work of Courses V., VI., and VIII. will be given hereafter by recitations to small sections. This change will involve a very material increase in the work on the part of the laboratory staff, but it is believed that the advantages to be derived from class-room conferences on this subject warrant the undertaking. The Departments of Mechanical Engineering, Mining Engineering, and Naval Architecture have also been able to introduce this work into their revised schedules which go into effect next year. The introduction of a course in precision of measurements into the schedules of all Engineering Courses has long been desired by the Department of Physics, as it would undoubtedly greatly enhance the value of the whole laboratory instruction to the students in those Courses.

In the Laboratory of Heat Measurements, in care of Professor Norton, the increased size of the classes has necessitated the duplication of much apparatus, and has seriously hampered the development of new work. Owing to the some-

what irregular way in which this laboratory has grown, and because in large part of its being a pioneer in the field, there is now an urgent need of a considerable expenditure of time and money for the reconstruction of much of our most important apparatus, which has chiefly been made from original designs and in our own shop, and which, in the light of the experience acquired in its use, can be greatly improved. The standardizing apparatus for mercury thermometers, the standard air thermometer, the controlled boiling point calibration apparatus, the recording pyrometers, thermal conductivity apparatus, and platinum resistance thermometers, need to be put in permanent shape and in most instances duplicated.

The electrical supply for resistance and carbon-reduction furnaces is now available, and several such furnaces are in use for instruction in the measurement and control of temperatures about 1,500° C.

Through the kindness of Mr. Samuel Cabot and Mr. Henry A. Morss, we have been furnished with the necessary funds to purchase the small refrigerating plant referred to in the report of last year as being greatly needed, and the apparatus will soon be contracted for. This will make it possible to furnish instruction in the measurement of low temperatures, and to determine conductivities and specific heats under the condition of actual service in the art of refrigeration.

During the past year the new Laboratory of Electro-Chemistry, in charge of Dr. Goodwin, has been fully equipped, and the previously announced courses of instruction were given to the members of the fourth-year class, which was the first class to elect the Option in Electro-Chemistry. A description of the arrangement and general equipment which had been planned for this laboratory was given in the President's Report for 1903. This has been followed out without material change, and has given eminent satisfaction in every respect. The general opinion expressed by recent scientific and professional visitors to the laboratory has been that for completeness of equipment and convenience of arrangement it is

unique. The most modern laboratory of the kind in Germany, although much larger, does not at all provide such facilities and equipment for each student as are to be found here. Ten of the twelve desks available were equipped last year, and all were immediately applied for, as is also the case this year. Increase beyond the present numbers is not desirable, at least until the present facilities can be duplicated; for under the present arrangement each student possesses a complete equipment of electro-chemical apparatus, and it is thereby possible to keep the laboratory instruction of the whole class in the closest touch with the lecture-room instruction. As the conditions to be met in dealing with large classes necessitate a wider and wider departure from this ideal system of instruc tion, the effectiveness and value of the instruction would inevitably diminish.

The installation for work in applied electro-chemistry has also given great satisfaction. The graded 50-kilowatt transformer with switchboard has proved admirably adapted for all classes of electric furnace work. This, together with the 25-kilowatt, Holtzer Cabot, direct current generator and the set of large accumulators, provides all the necessary sources of electrical energy at present needed for work on electrodepositions, electrolytic refining and winning of metals in the wet way and in the electric furnace, and on electro-chemical preparations in general. It is the aim of the instruction in the technical work to attempt to carry out processes not on a commercial scale, but rather on a scale sufficiently large to illustrate the principles involved and the chief difficulties to be overcome. In the work of installing the plant and in the development of new laboratory methods, Dr. Thompson has rendered most valuable assistance.

The electrical plant for the supply of electrical power to the Laboratories of Heat Measurements and Electro-Chemistry has been purchased and installed under the direction of Professor Derr, and is now substantially complete. It operates to our entire satisfaction. The original appropriation of

$3500 has not been exceeded, and contrary to expectation there will be no necessity of further expenditure until the laboratories call for a considerably greater supply than is likely to be needed for several years. That so much has been accomplished in proportion to the outlay is largely due to the kindness of Mr. F. C. Sutter, M. I. T. '93, of the Pittsburgh Transformer Co., by which company five of the large transformers were constructed.

The principal items of the plant under consideration are as follows: —

1. One 25-kilowatt motor generator (purchased by Professor Goodwin) complete with switches, bus-bars, voltmeter and ammeters.

2. One 50-horse-power, direct current motor with circuit-breaker and ammeter for driving the alternator, which machine was already in possession of the department.

3. One 50-kilowatt, graded transformer of special design with switchboard, to give currents from 300 to 4,800 amperes, at pressures from 160 to 10 volts.

4. Three 20-kilowatt transformers, for connection to the three-phase circuit from the electrical engineering laboratory, with a switchboard giving four different voltages and currents up to 400 amperes on each side.

5. One 20-kilowatt transformer, for low voltages and currents up to 2,000 amperes. This is mounted upon a truck and can readily be taken to any part of the laboratory.

6. A full set of measuring instruments, in addition to the switchboard voltmeters and ammeters. With them it is possible to measure currents from 1 to 1,500 amperes, voltages from 10 to 160 volts, and power up to the limits of the supply.

The 50-kilowatt transformer and the switchboards are from the designs of Professor Derr.

The statements made in my report of last year regarding the great need of additional rooms for conference purposes and for the proper keeping of the physical apparatus are still

true, and the need becomes more urgent with the growth of the Department. We also greatly need more space for the Optical Laboratory, which is greatly cramped, and for the proper development of a Photographic Laboratory.

CHARLES R. CROSS.

DEPARTMENT OF GEOLOGY.

In Course XII., no significant changes have been made. Two students have been engaged in the work of the Course during the past year. The most important advance in the work of the department has been the establishment of a third option in Course III., mining geology; and arrangement has further been made whereby all students of mining engineering shall in the future gain some acquaintance with practical geological surveying. The class of second-year students in general geology, which numbered one hundred and thirty-eight in 1903–04, and was obliged to meet in Huntington Hall, has been divided in 1904–05, so that the students of Course III. take the work in the first term, those of Course I. in the second. The class is thus enabled to meet in the geological lecture-room, where suitable maps, a stereopticon, etc., are provided. The total registration in studies under the department for 1903–04 was seven hundred and forty-six.

Professor Jaggar conducted an advanced summer course in geological surveying to the Black Hills and Big Horn Mountains in July and August. Six students completed the work, representing six different colleges, one of them being of the class of 1904 of the Institute. Several of these men made field studies which will be published. Professor Jaggar completed, in 1903–04, in collaboration with Professor Charles Palache, the text and maps of the folio of the Bradshaw Mountains, Arizona, for the United States Geological Survey. In the summer he was able to review on the field the work of the Spearfish–Sturgis Folio of the northern Black Hills,

S.D., which he is now finishing. With a grant from the Elizabeth Thompson Science Fund he is preparing a memoir on Experimental Geology, and some progress has been made during the past year on a report dealing with the Caribbean Volcanic Eruptions of 1902. He has under construction a laboratory instrument for measuring the hardness of minerals and metals, in pursuance of investigations begun in 1896 (published in *The American Journal of Science*, December, 1897). In midwinter, 1903–04, he spent the Christmas season in Searchlight, Nevada, making investigations for the Quartette Mining Co. of Boston.

Professor Crosby has begun a systematic investigation of the building stones of Boston, in connection with the thesis study of Mr. G. F. Loughlin. This has in part been published in the *Technology Quarterly*. Professor Crosby gave the summer to original study and investigation, in min ing geology: including chiefly the auriferous gravels of the Nome District in Alaska and the Klondike District in Yukon Territory, continuing investigations begun last year; the copper deposits of the Whitehorse District, Yukon Territory; the new coal and oil fields of the Kayak District in Alaska and the deposits of copper and precious metals in the Bingham and Tintic Districts in Utah. This work has resulted, in every instance, in the addition of valuable material to the economic collections of the Institute.

Professor Warren reports some additions to the mineralogical and petrographical collections; and improvements in the course of mineralogical study taken by the students in mining engineering. For the new geological option in Course III. there is great need of more microscopes and microscopical preparations for accommodating the increased number of students in the Petrographical Laboratory. In the Mineralogical Laboratory investigations are in progress on the composition and characteristics of certain "rare earth" minerals, and on the crystallization of minerals from molten solutions. Rock analyses are being made in connection with a petrographical study of a complex of igneous rocks near Cumberland, R.I.

Dr. D. W. Johnson has developed a unique and useful course for students of civil engineering, in topographic geology. Critical study of topographic maps has been made the basis of the work, and some three thousand and five hundred maps have been added to the collection, classified, and mounted for handling by large classes. In the field-work the student learns to correlate land forms, geologic structure, and the topographic map; and this has been systematized by the aid of printed programs with brief outlines of the features studied. With the aid of the stereopticon, features remote from our own field of study are illustrated. Dr. Johnson has further taken charge of the third-year course in economic geology. He spent two weeks in the spring of 1904 in the Chattanooga District of Tennessee, Georgia and Alabama, making special studies of the topography and drainage modifications. The results of this investigation are in press; and he has also completed two other studies for publication as follows: one on "The relation of the law to underground waters" (Water Supply and Irrigation Papers, U.S. G. S.) and one on "The distribution of fresh water faunas as an evidence of drainage modifications."

Dr. Shimer had charge of the work in palæntology and historical geology, and, during the year, rearranged the geological library and recatalogued all the maps in the collection.

T. A. JAGGAR, JR.

DEPARTMENT OF NAVAL ARCHITECTURE.

The quarters provided for the Department of Naval Architecture in the building erected in the summer of 1903 have been found well adapted for the purpose, and I have no suggestion at the present time for alterations. Should, however, the building be enlarged at some future time, I shall desire to ask for some part of such extension. During the summer vacation just closed, an alcove at the north end of the main

drawing-room was enclosed to form a library and reading-room; this provides for the present for an essential feature in the work of the department. It is proper to mention here a very valuable collection of books from the library of the late Henry Bryant, which was presented to the department by Dr. Charles G. Weld, who also provided bookcases for the library.

The model shop, provided through the interest of Dr. Weld, has been kept open by him during the year at convenient times, and about fifty students, including three Naval Constructors, have received instruction in model making. Some of the models made during the previous year were used for laying on the plating of the hull. Several of the models have been properly mounted and hung where they can be used for illustration and reference in future instruction in design. The importance of experience in cutting models to lines which the student has himself designed is emphasized by our experience since the shop was opened.

The department was informed during the summer of 1903 that the pressing demand for officers in the navy precluded the assignment of a new class of officers to study naval architecture; nevertheless, before the fall term was concluded, the Chief Constructor succeeded in obtaining the detail of a class of three men, who began work in January and are doing the regular work of their Course this year.

A new class of eight ensigns entered in regular order at the beginning of this year. This makes a total of twenty officers at the Institute at the present time. The first class from the Course was graduated in June; they had, by special arrangements, completed the Course and been assigned to duty in the preceding April.

Professor Peabody has published a work on Naval Architecture which presents the theoretical instruction in naval architecture given to classes in the department, including the Naval Constructors. This work had formerly been used in the form of type-written notes, and there is an appreciable advantage in the presentation in a well printed book.

Two papers have been presented to the Society of Naval Architecture and Marine Engineers: one on Water-tight Subdivision of War-ships by Professor Hovgaard, and the other on Displacement and Stability Calculations, by Mr. Leland.

Through the interest of Dr. Weld, a course of lectures once a week throughout the school year has been arranged to be given by gentlemen engaged in the practice of the profession, on subjects to which they have given special attention; this course is sure to be interesting and profitable and in particular will give students a broader and juster view of the profession into which they are to enter.

C. H. PEABODY.

DEPARTMENT OF MATHEMATICS.

There have been no important changes in the work of the Department of Mathematics during the past year.

An effort has been made to equalize the difficulty of the courses in algebra and trigonometry in the first half of the first year by transferring the discussion of the principles of logarithms from the algebra to the trigonometry, where it finds its application, and this has made it possible to include in the algebra the more extended use of graphical methods, with expectation of corresponding advantage in taking up the second-term work in analytic geometry. The transition from the more familiar subjects of the first term to the analytic geometry of the second has proved in the past one of great difficulty to first-year students, and whatever will give them a better start in the second-term work will be an important gain in our first-term work.

A recent change in the Faculty rules makes it necessary for students in the principal professional departments to secure mathematical records better than "L" (passed with low standing) for admission to second-year professional sub-

jects. This will tend to secure both better work in the first year and fewer failures in the second.

In calculus Professor Osborne has prepared printed notes supplementing his text-book, in anticipation of the publication of a new edition. The return to the former policy of holding final examinations in calculus has resulted on the whole to the satisfaction of the department.

Efforts to secure closer relations with professional departments have been continued, with the assignment of particular members of the Mathematical Department to corresponding groups of students, so far as the exigencies of the tabular view have permitted this to be done. In this manner one or two instructors, for example, have charge of the work in calculus of students in Civil and Sanitary Engineering, and are expected to inform themselves somewhat as to the applications of the calculus which these students will make in their future work.

Advanced elective courses were given last year by various members of the department on the calculus of variations and minimum surfaces. While we rarely have students who are interested primarily in mathematics, the development of the Course for Naval Constructors and the increasing number of graduate students taking a part of their work in mathematics offer a welcome opportunity for the introduction of advanced courses. A course in the elements of theoretical hydrodynamics is now in progress for the first time.

The personal changes in the department have been unusually numerous. Professor Skinner at the expiration of his leave of absence has preferred not to return, and has terminated his connection with the department, carrying with him in his retirement the cordial good wishes of his colleagues. Dr. Mason has accepted an attractive opportunity at Yale University, and Mr. Camp has returned to Wesleyan University, his Alma Mater. Mr. Miller has been granted leave of absence for the continuation of his mathematical studies, and is now attending the University of Göttingen.

These retirements have been in part offset by Professor Bartlett's return from his year in Europe, and by the appointment of Dr. C. L. E. Moore, a graduate of the Ohio State University and Cornell University. Professor Bartlett has visited most of the German Polytechnics, spending considerable time at Charlottenburg and at Munich, and making briefer stays in Italy and in France. A fuller report will be presented independently, and the results of it will have due influence, not only in his own work, but in that of the department as a whole.

In regard to the needs of the department, it is to be hoped that it may be practicable in the near future to restore the previous annual appropriation of $250, to provide by special appropriation for increasing our collection of models, and for filling certain gaps in our library.

H. W. TYLER.

DEPARTMENT OF DRAWING.

The new system of instruction inaugurated last year by Professor Adams was carried to a successful completion and resulted in a high percentage of good work. Several new pieces of apparatus have been added to the lecture-room, notably a large revolving glass frame for illustrating the principles of descriptive geometry. As many geometrical models and machine castings have been procured as the yearly appropriation warrants. The framed examples of machine drawing and bridge design from the best drafting offices tend to make the drawing-room more attractive in appearance. The notes on mechanical drawing given out by Professor Adams last year have been gathered into book form, and will be published during the present year. A new book on descriptive geometry is in process of preparation; and it is intended in this book to present the subject as a branch of drawing rather than of mathematics.

The summer school in descriptive geometry was in charge of Mr. H. C. Bradley, assisted by Messrs. E. S. Foljambe and J. R. Putnam. It was held somewhat later than usual and on this account attracted more college graduates wishing to anticipate first-year work.

ALFRED E. BURTON.

DEPARTMENT OF MECHANIC ARTS.

The total number of students receiving instruction in the Mechanical Laboratories is three hundred and fourteen. Some take work in more than one class, the numbers attending in the several subjects given during the first term being as follows: —

Carpentry and Wood Turning, II. and X.	71
Joinery and Pattern Work, VI.	33
Forging, II. and XIII.	106
Metal Turning, VI. and VIII.	37
Machine-Tool Work, II. and XIII.	86
Pipe Fitting, XI.	8
Total in classes	341
Students taking work in two or more classes and counted more than once	27
Total number of students	314

The total number of students attending last year was three hundred and eighty-two, the reduction in number being mainly due to excuses granted to students who had taken wood-work and forging in manual training schools.

The attendance in the summer school was the largest since its beginning in June, '98, the several classes numbering as follows: —

Wood-work	11
Forging	16
Chipping and Filing	12
Machine-Tool Work	31
Total	70

Had not some twenty-four students anticipated their machine-tool work, the classes in that subject would this year have been larger than could be accommodated.

One engine-lathe, a planer, and a pipe-fitting bench have been added to the equipment of the machine-tool laboratory.

Fourteen engine-lathes and a planer purchased in 1876 should be replaced by new and modern tools, if the present high standard in work is to be maintained. A universal grinding machine, a small radial drill, and a universal milling machine are very much needed to carry out the general class instruction successfully with the present large sections. The attendance during the second term will undoubtedly be larger, and the present equipment will be taxed to its utmost. Judging from present indications, additional lathes will be needed next year.

Moving the filing laboratory to the second floor of the Mechanic Arts Building necessitated the purchase of a double tool grinder. A band saw has been added to the equipment of the wood-working laboratory. The forging laboratory is in as good condition as can be expected after twenty-one years' use, but a renewal of this equipment, while desirable, is not recommended, on account of the probable early removal of the mechanical laboratories from their present location.

Instruction rooms are very much needed in the filing, wood-working, and forging laboratories, and it is earnestly recommended that such be provided this year. With the present arrangement of classes the wood-working and forging laboratories can easily accommodate the classes, but the filing laboratory was taxed to its full capacity this year.

It is believed that instruction in foundry work should be given to every student in Mechanical Engineering, because of the value of a knowledge of this important subject in many industrial works to-day. The course at present is optional, but, according to a vote of the Faculty, instruction is to be given to the students in Chemical Engineering next year, for which provision must be made. The large optional classes show a demand for this training, and it is earnestly recommended that a new and larger melting plant be installed and

that a permanent instructor be appointed. This department can then supply castings which are now purchased outside.

Mr. James F. Leary, Assistant in Chipping and Filing, resigned to accept a position as Instructor in Drawing and Wood-work in the Holyoke high school. Mr. Marshall G. Meriam, a former special student, has been appointed in his place. Mr. J. F. O'Neill, Assistant in Wood-work and Foundry-work, resigned to take charge of the manual training at the Malden high school. Mr. Albert L. Moulton, an experienced wood-worker, has been appointed in his place. The instructing staff now numbers four instructors and five assistants.

PETER SCHWAMB.

DEPARTMENT OF ENGLISH.

The English Department during the past year has been carrying on the policy of connecting its work as closely as possible with the technical studies of the various Courses. The number of technical papers which come to the department for correction has increased, and these, with the written translations from the classes in French and German, help to make the drill in composition continuous and more obviously an integral part of the technical training.

The increase of the time allotted to second-year English literature in Courses I. and XI. has made possible much more satisfactory work in the first term. The whole second-year literature has been further improved by the division of the class into sections, and the introduction of a printed syllabus.

The elimination of Course IX. from the lower years has been cutting off several of the courses formerly given; but some of these have been continued as options in response to demands from men in engineering Courses. Logic, which has been dropped out of the first year, and advanced composition, dropped from the third, are both being given as volunteer courses on account of application made for them by students

in Courses still existing. The arrangement is hardly a satisfactory one, as regards either students or instructors. Neither can satisfactorily plan work in advance, in view of the uncertainty whether such courses will be given; and in any case valuable time is lost in making arrangements.

A vacancy caused by the resignation of Mr. C. H. L. Johnston has been filled by the appointment of Mr. C. L. Collester.

ARLO BATES.

DEPARTMENT OF HISTORY.

The work in history is at present, in some respects, in a transition stage. The subjects required of all regular first- and second-year students, as well as that taken by fourth-year students in Architecture, continue to be given as usual. Course IX., however, as a course in general studies, will cease to exist at the end of the present school year, and accordingly its own special history courses will then be dropped. Next year and thereafter a considerable variety of options in history and government will be offered to students of the third year, who will have a certain amount of time available for studies of a general character.

CHARLES F. A. CURRIER.

DEPARTMENT OF MODERN LANGUAGES.

The work of the Department of Modern Languages has, in general, been carried on along the lines indicated in the last Report.

The following changes in the staff of the department are to be noted. Professors Rambeau and Dippold, and Mr. Goodell have resigned and gone to other fields of usefulness, carrying with them the best wishes of the department. Professor Vogel has been appointed acting head of the department for the first term of the current year. Messrs. Hare and Lenz have been appointed Instructors in Modern Languages for the

year 1904–1905. They come to us as graduates of Harvard College, with a business as well as a teaching experience, added to youthful enthusiasm, and have already shown themselves well qualified for the work intrusted to them.

The Department of Modern Languages offers in 1904–1905 six courses in French, six in German, three in Spanish, and one in Italian. The entire enrolment in these courses at present is nine hundred and forty-five as against nine hundred and twenty-two in all courses offered last year. Courses in conversation and foreign correspondence have been added in French and German, and one course in advanced German literature.

The effect of our new entrance requirements in modern languages is beginning to make itself felt in the distribution of our work.

The total number of students in French I. and German I. (both elementary) at the time of the last report was three hundred and twenty-five, divided as follows: French I., one hundred and six, German I., two hundred and nineteen. This year the total number is only one hundred and forty-one, divided as follows: French I., sixty-six, German I., seventy-five, which numbers will, no doubt, be even smaller in the future. These courses are now given merely as an accommodation for those who have not been able to meet our requirements before entering the Institute. In general, it appears that the preparatory schools have better facilities for meeting our requirements in French than in German. However, improvement is noticeable and in a few years we may hope to have the entrance requirements fully met in each subject. This will tend to make the work in the required courses French II. and German II. in the Institute even more effective and practical.

While the main object of all required modern language work at the Institute must always be the acquisition of a good and ready *reading* knowledge, yet the department aims to do even more than this by rousing an interest in and for

the institutions and life of the people whose language is studied. To this end the department is glad to offer advanced courses adapted to the needs and wishes of the applicants, and at hours suiting their convenience. The interest in these optional and elective courses offered by the members of this department is very gratifying. The course in German sight reading has increased this year to twenty-five members as against four last year. The course in German conversation and foreign correspondence numbers forty-four. The course in French conversation has thirteen members, and the call for Italian has found the department ready to give a course in the elements of this language to eleven men. Interest in Spanish has grown since last year so that it was necessary to form two classes in elementary Spanish, containing sixty-eight students, as against forty-eight last year. Spanish II. has risen from three students last year to eighteen this year. The classes in French and German literature are still small (seven and five respectively), but they promise well for the future.

The courses in French II. and German II. required of all students who are candidates for a degree aim to give the greatest facility attainable for reading intelligently scientific works in French and German. The efficiency in this work will be greatly increased by a modification of the arrangement entered into with the Department of English, whereby all students in French II. and German II. will once a month write a translation of a passage selected from some scientific work written in French or German, aiming to reproduce the meaning of the original in the best English at the student's command. This translation will then be criticised by the members of the Department of English with special attention to the English expression, and returned to the student marked for further study, or to be re-written as the case may require.

A plan has been evolved whereby the Library of the Department of Modern Languages will become more useful for the student body The Library will be opened every

school day for study, consultation of reference books, and loaning books for home use.

The Library will probably receive a considerable increase through an agreement of the most important publishers of foreign language text-books to donate copies of their publications for reference and use by students, as well as by the members of the department. These donations are to the Library of the Department of Modern Languages at the Institute of Technology. Ginn & Co., Boston; Silver, Burdett & Co., Boston; and Heath & Co., Boston, have already sent a considerable number, and their example will probably be followed by all the leading publishers. This will put a valuable educational library of modern language books within the reach of all our students and instructors.

The number of hours of instruction given by each member of the department averages seventeen per week, and a considerable amount of time is consumed in correcting written work. While the members of the department have not published anything of great moment beyond what was reported in preparation at the time of the last report, it may be mentioned that Professor Vogel, Mr. Dike, and Dr. Kurrelmeyer, each has in preparation something which will go to press during the ensuing year.

FRANK VOGEL.

THE LIBRARIES.

The gross accessions to the libraries of the Institute during the year 1903–4 amount to 4,829, as follows: —

TABLE OF GROSS ACCESSIONS CLASSIFIED BY SOURCES.

By Purchase, volumes	1,251
By Purchase, maps	960
By Binding	930
By Gifts	1,688
Total	4,829

After deducting losses and books counted twice, the net increase of the library amounts to 3,089 volumes, 760 pam-

phlets, and 960 maps,— making the total number of volumes in the libraries of the Institute 67,361, and the number of pamphlets and maps, 19,558. The following table gives the particulars of the growth of the several libraries in volumes, pamphlets, and maps, with the amount expended for the accessions to each library, and its present total contents: —

TABLE OF THE NET INCREASE, WITH THE COST OF THE SAME, DURING THE YEAR 1903–04, AND THE TOTAL CONTENTS OF THE LIBRARIES OF THE INSTITUTE, SEPT. 30, 1904.

LIBRARIES.	Net Increase.				Total Contents.	
	Volumes.	Pamphlets.	Maps.	Cost.	Volumes.	Pamphlets and Maps.
General Library:						
General	146	252	—	$172.71*	5,505	4,727
English	117	—	—	183.82	3,228	44
Military Science	—	—	—	3.20†	332	7
Walker Memorial	146	—	—		371	—
Drawing	22	—	—	‡	22	
Totals General Library	431	252	—	$359.79	9,538	4,778
Architecture	208	3	—	220.48	3,536	236
Biology	245	55	—	334.45	3,026	617
Chemistry	323	43	—	754.53	9,382	1,751
Electrical Engineering	176	12	—	300.02	821	33
Engineering	545	184	—	833.41	11,415§	4,209§
Geology	133	40	960	92.62	2,542	2,404
History and Economics	473	70	—	432.72	12,110	3,517
Margaret Cheney Room	2	—	—	-	670	13
Mathematics	75	—	—	162.56	1,300	208
Mining	196	62	—	300.20	3,664	629
Modern Languages	24	2	-	74.73	1,103	29
Naval Architecture	—‖	—‖	—	—‖	709	65
Physics	258	37	—	409.37	7,445¶	979
Totals	3,089	760	960	$4,424.88	67,361	19,558

* Includes cost of books purchased for Secretary's Office and for Drawing Department.
† Subscription to a periodical not bound.
‡ Included in General.
§ After 709 volumes and 65 pamphlets had been transferred to Naval Architecture.
‖ Included in Engineering.
¶ Apparent error in this item in Report for 1902–03 was due to the transfer of 396 volumes from Physics to Electrical Engineering.

The advance of science and technology along new lines is marked by the frequent appearance of new periodicals established to record the progress of research and endeavor in these new directions. The Institute, in order to keep up with the times, must have these journals. The number of periodicals and other serial publications received during the year 1903–04 was 944, an increase of 14 over the previous year. The following table shows the number and cost of the serial publications charged to each account and for each department.

TABLE OF PERIODICALS AND OTHER SERIAL PUBLICATIONS RECEIVED DURING THE YEAR 1903–04, CLASSIFIED BY DEPARTMENTS AND METHOD OF PAYMENT.

LIBRARIES.	Number Received.					Estimated Cost.			
	Gifts.	Charged to Department.	Periodical Account.		Totals.	Dept. Account.	Periodical Account.		Totals.
			Exch.	Subs.			Exch.	Subs.	
General	43	19	14	25	101	$53.92	$28.00	$73.03	$154.95
Architecture	9	9	3	31	52	38.32	6.00	148.58	192.90
Biology	6	9	19	34	68	31.94	38.00	224.61	294.55
Geology	11	2	4	7	24	18.50	8.00	37.77	64.27
Chemistry	15*	38	14	29	96*	131.17	28.00	162.96	322.13
Engineering	34	50	65	60	209	125.15	132.00	244.45	499.60
Electrical Engineering	3	16	9	6	34	70.58	18.00	31.10	119.68
History and Economics,	56	38	2	40	136	74.98	4.00	130.14	209.12
Mathematics	—	2	—	17	19	4.10	—	66.54	70.64
Mining	7	12	35	24	78	33.07	70.00	106.64	209.71
Modern Languages	—	2	—	17	19	4.91	—	75 12	80.03
Naval Architecture	2	12	4	5	23	45.32	8.00	16.95	70.27
Physics	15	15	23	22	75	50.66	46.00	103.57	200.23
Walker Memorial	9	—	—	—	9				
Margaret Cheney Room,	1	—	—	—	1				
Totals.	211	244	192	317	944	$682.62	$384.00	$1,421.46	$2,488.08

There were added to the general catalogue during the year 4,927 cards, making the total number of entries in the catalogue 65,534. There were issued 1,034 orders for new books and periodicals and 1,124 orders for binding. In five of the Libraries records were kept of the number of books borrowed, with the following results: —

* Not including Experiment Station reports.

General Library	1,428
Biological	210
Chemical	1,844
Engineering	1,346
Mining	1,804

Soon after the General Library was transferred, several years ago, to its present quarters, the experiment of keeping the room open in the evening was tried. There was no response on the part of the students, however, and after a month it was closed. Last February, at the suggestion of Dean Burton, the experiment was tried again, and this time with much better results. Two students were appointed to act as Attendants from five to seven o'clock and from seven to ten, respectively; and they have kept records of the number of readers, which may be summarized as follows: —

NUMBER OF READERS IN THE GENERAL LIBRARY DURING THE EVENINGS OF 72 DAYS FROM FEBRUARY 17 TO JUNE 3, 1904.

Hours	5-7	7-10
Average attendance	20	9
Minimum	4	0
Maximum	69	33

Owing to the generosity of Dr. Charles G. Weld, we were able during the summer to enclose an alcove off the drawing-room for naval architecture, and into the new room have been moved 709 volumes and 65 pamphlets from the Engineering Library, thus establishing a new departmental Library of Naval Architecture. To these Dr. Weld has added a collection of books consisting of 173 volumes and 7 pamphlets, many of them old and rare works of great value, which formerly belonged to the late Henry Bryant, Esq. This collection has not yet been regularly incorporated in the library, and therefore does not appear in the statistics of this report. Dr. Weld has also given a number of new books to the Institute for this department, including Holmes, "Practical Shipbuilding," and two copies of Walton, "Steel Ships."

The donor of the Library for the Walker Memorial has enlarged his gift this year by 146 volumes, and he has continued the subscription to 9 periodicals. Among other gifts, we

have received from Harry F. Noyes — 38 volumes of U.S. Consular Reports; from Mrs. Cheney for the Margaret Cheney Room — Poems of Wordsworth; Van Dyke, "Little Rivers"; *The Outlook; Scribner's Magazine*, and the *Literary Digest;* from M. Guggenheim, of Venice — a work entitled "Papadopoli Palace"; from the Swedenborg Publishing Co.— the Works of Swedenborg, 25 volumes; from the authors — Wells, "Advanced Course in Algebra"; Peabody, "Naval Architecture"; Bridge, "Inside History of the Carnegie Steel Company"; Carhart, "Physics for University Students."

R. P. BIGELOW.

THE SOCIETY OF ARTS: REPORT OF THE SECRETARY.

To the President of the Massachusetts Institute of Technology:

Sir,— On behalf of the Executive Committee I have the honor to present the annual report of the Society of Arts for the year May 22, 1903, to May 26, 1904.

Fifteen meetings have been held, usually on the second and fourth Thursdays of each month from October to May, inclusive. The average attendance has been about one hundred and seventy-five, the largest being about four hundred, and the smallest forty-five. The general interest in the Society which has been manifested during the past few years has been maintained.

The following papers have been presented before the Society: —

American Rapid Transit in the Light of European Experience, by Mr. John P. Fox.

Solar Evaporations: Their Development and Use in Water Engineering, by Captain William H. Jaques.

Mosquitoes, and Suggestions for their Extermination, by Mr. William Lyman Underwood.

One Field of Twentieth Century Science, by Professor Simon Newcomb.

The Influence of Food Preservations on Digestion, by Dr. Harvey W. Wiley of the U.S. Department of Agriculture.

Steam Turbines, by Mr. Charles Garrison.

The Use of Electricity in Metallurgy, by Professor Joseph W. Richards of Lehigh University.

The Chemical Work of the U.S. Geological Survey, by Dr. F. W. Clarke, Chief Chemist of the U.S. Geological Survey.

The Action of Radium and Ultra Violet Light on Minerals and Precious Stones, by Mr. George F. Kunz.

The Preservative Treatment of Wood, by Dr. Samuel P. Sadtler.

The Measurement of the Heat of the Stars, by Professor E. F. Nichols of Columbia University.

The History and Work of the Smithsonian Institution, by Dr. Cyrus Adler, Librarian of the Smithsonian Institution.

The Recent Conflagration in Baltimore, by Professor Charles L. Norton of the Institute.

Coinage and the Precious Metals, by Mr. George E. Roberts, Director of the U.S. Mint.

Mechanical Flight, by Mr. J. Emery Harriman, Jr.

During the year one life member and fourteen associate members have been elected to the Society. The total membership at the end of the year is three hundred and sixty-two.

The *Technology Quarterly* has appeared regularly during the year under the editorship of Dr. R. P. Bigelow. In addition to the Proceedings of the Society twenty-two articles and several book reviews have been published.

At the forty-second annual meeting held on May 19, 1904, the following-named gentlemen were elected officers of the Society for the year 1904–05:—

Executive Committee.— George W. Blodgett, Edmund H. Hewins, Charles T. Main, James P. Munroe, and A. Lawrence Rotch.

Secretary.— Samuel C. Prescott.

Board of Publication.— W. T. Sedgwick, Dwight Porter, H. E. Clifford, Henry Fay, and R. P. Bigelow.

Respectfully submitted,

SAMUEL C. PRESCOTT, *Secretary.*

Publications.

CHEMISTRY AND CHEMICAL ENGINEERING.

HENRY P. TALBOT.— Study Questions in Inorganic Chemistry and Qualitative Chemical Analysis. Boston, 1904. Thomas Todd.

WILLIAM H. WALKER.— A Laboratory Course in Industrial Chemistry. *Technology Review*, Vol. VI., No. 2, 1904.

WILLIAM H. WALKER and L. M. BOURNE.— The Hydrolytic Enzyme Contained in Castor-oil Seeds. *Technology Quarterly*, Vol. XVII., p. 284.

AUGUSTUS H. GILL and S. A. FOSTER.— Contribution to our Knowledge of White Lead and of its Protecting Properties. *Technology Quarterly*, Vol. XVII., p. 145.

AUGUSTUS H. GILL and S. N. MASON.— The Detection of Mineral Oil in Distilled Grease Oleines. *Journal of the American Chemical Society*, Vol. XXVI., pp. 665–672.

ELLEN H. RICHARDS.— First Lessons in Food and Diet. Whitcomb & Barrows, Boston, 1904.

ELLEN H. RICHARDS and ISABEL F. HYAMS.— Notes on Oscillaria Prolifica. Third Paper: Coloring Matters. *Technology Quarterly*, Vol. XVII., p. 270.

ELLEN H. RICHARDS and LILY M. KENDALL.— Permanent Standards in Water Analysis. *Technology Quarterly*, Vol. XVII., p. 277.

ELLEN H. RICHARDS and A. G. WOODMAN.— Air, Water, and Food from a Sanitary Standpoint. Second Edition. John Wiley & Sons, New York, 1904.

ALPHEUS G. WOODMAN.— The Exact Estimation of Atmospheric Carbon Dioxide: A Brief Survey. *Technology Quarterly*, Vol. XVII., p. 258.

S. P. MULLIKEN.— A Method for the Identification of Pure Organic Compounds by a Systematic Analytical Procedure Based on Physical Properties and Chemical Reactions. Vol. I. Compounds of Order I. John Wiley & Sons, New York, 1904.

GEORGE W. ROLFE and CHARLES FIELD, 3d.— Some Notes on Laurent Polariscope Readings. *Journal of the American Chemical Society*, Vol. XXVI., p. 986.

GEORGE W. ROLFE and F. H. STORER.— Observations on a Malt Glucose, known as "Midzu-ame," made in Japan from Rice and Millet. *Bulletin of the Bussey Institution of Harvard University*, December, 1904.

WILLIAM T. HALL.— Analytical Chemistry. Vol. II. Quantitative Analysis. Translated from the German of F. P. Treadwell.

A. A. BLANCHARD.— The Viscosity of Solutions in Relation to the Constitution of the Dissolved Substance. *Journal of the American Chemical Society*, Vol. XXVI., p. 1315.

A. A. BLANCHARD.— Ueber die Zersetzung des Ammoniumnitrits. *Zeitschrift für physikalische Chemie.*

MILES S. SHERRILL and STANISLAUS SKOWRONSKI.— A Study of the Mercury Sulphocyanate Complexes. *Journal of the American Chemical Society.*

ROY W. MOORE and W. LOEB.— Die Bedeutung des Kathodenmaterials für die elektrolytische Reduktion des Nitrobenzols. *Zeitschrift für physikalische Chemie*, Vol. XLVII., p. 418.

NELSON E. TOUSLEY and M. GOMBERG.— Some Tri-p-tolylmethane Derivatives. *American Chemical Journal*, 1904.

RESEARCH LABORATORY OF PHYSICAL CHEMISTRY.

Serial Contributions of the Laboratory.

No. 1.— A. A. NOYES and W. D. COOLIDGE.— The Conductivity of Aqueous Solutions at High Temperatures. 1. Description of the Apparatus. Results with Potassium and

Sodium Chloride up to 306°. *Proceedings of the American Academy of Arts and Sciences*, Vol. XXXIX., pp. 163–219, 1903. *Zeitschrift für physikalische Chemie*, Vol. XLVI., pp. 323–378, 1903.

No. 2.— H. M. GOODWIN and R. HASKELL.— The Electrical Conductivity of Very Dilute Hydrochloric and Nitric Acid Solutions. *Proceedings of the American Academy of Arts and Sciences*, Vol. XL., pp. 399–415, 1904. *Physical Review*, Vol. XIX., pp. 369–386, 1904.

No. 3.— C. S. HUDSON.— The Hydration of Milk-sugar in Solution. *Journal of the American Chemical Society*, Vol. XXVI., pp. 1065–1082, 1904.

No. 4.— W. R. WHITNEY and J. C. BLAKE.— The Migration of Colloids. *Journal of the American Chemical Society*, Vol. XXVI., pp. 1339–1387, 1904.

No. 5.— A. A. NOYES.— A System of Qualitative Analysis, including nearly all the Metallic Elements. Part II. Analysis of the Tungsten Group. *Technology Quarterly*, Vol. XVII., pp. 214–257, 1904.

No. 6.— A. A. NOYES.— The Properties of Salt Solutions in Relation to the Ionic Theory. *Science*, Vol. XX., pp. 577–587, 1904. *Technology Quarterly*, Vol. XVII., p. 293, 1904.

Other Publications of the Research Staff.

W. BÖTTGER.— Löslichkeitsstudien an schwerlöslichen Stoffen. *Zeitschrift für physikalische Chemie*, Vol. XLVI., pp. 521–619, 1903.

C. A. KRAUS.— The Electrical Conductivity of Solutions in Methyl Alcohol in the Neighborhood of their Critical Points. *Physical Review*, Vol. XVIII., pp. 40–56 and 89–103, 1904.

BIOLOGY.

W. T. SEDGWICK.— Why Dirt is Dangerous. *Journal of the Massachusetts Association of Boards of Health*, Boston, May, 1904.

W. T. SEDGWICK.— Why Dirty Milk is Dangerous. *Journal of the Massachusetts Association of Boards of Health*, Boston, August, 1904.

W. T. SEDGWICK.— Chicago Drainage Canal Case. *Record of Evidence, Supreme Court of the United States, State of Missouri* vs. *The State of Illinois and the Sanitary District of Chicago*. Vol. III., pp. 2184–2417; 2758–2789. Vol. VIII., pp. 7955–7974. Jefferson City, Mo., Tribune Publishing Company, 1904.

W. T. SEDGWICK.— Article on "Sanitary Science and Public Health." *Encyclopædia Americana*, Vol. XIV. New York, 1904.

S. C. PRESCOTT (with C.-E. A. WINSLOW).— Elements of Water Bacteriology, with Special Reference to Sanitary Water Analysis. New York, John Wiley & Sons, 1904. pp. 162 + x. 8vo.

S. C. PRESCOTT.— A Note on Methods of Isolating Colon Bacilli. *Science*, N.S., Vol. XVI., No. 408, pp. 671–672.

S. C. PRESCOTT (with S. K. BAKER).— On Some Cultural Relations and Antagonisms of Bacillus Coli and Houston's Sewage Streptococci, with a Method for the Detection and Separation of these Micro-organisms in Polluted Waters. *Journal of Infectious Diseases*, Vol. I., No. 1, pp. 193–210. *Report of the American Public Health Association*, Vol. XXIX., pp. 369–384.

S. C. PRESCOTT.— Report of Committee on Significance of Bacillus Coli in Water Supplies. *Report of the American Public Health Association*, Vol. XXIX., pp. 356–358.

S. C. PRESCOTT.— The Effect of Radium Rays on the Colon Bacillus, the Diphtheria Bacillus and Yeast. *Science*, N.S., Vol. XX., No. 503, pp. 246–248.

S. C. PRESCOTT.— Ptomaines and Ptomaine Poisoning. *Good Housekeeping*, Vol. XXXIX., No. 4, October, 1904, pp. 444–447.

R. P. BIGELOW.— Articles on "Segmentation of the Body," "Segmentation of the Ovum," "Senility," "Sex," "Sperma-

tozoa," and "Variation" in the *Reference Handbook of the Medical Sciences* (revised edition), Vols. VII. and VIII. New York, William Wood & Co., 1904.

A. W. WEYSSE.— A Text-book of Synoptic Zoölogy. New York, Macmillan & Co., 1904. pp. 514 + xxv. 8vo.

A. W. WEYSSE.— Notes on Animal Behavior. *Science*, N.S., XIX., 955, June, 1904.

A. W. WEYSSE.— The Study of Morphology as an Adjunct to the Study of Medicine. *Bostonia*, V., 13, July, 1904.

C.-E. A. WINSLOW (with S. C. PRESCOTT).— Elements of Water Bacteriology, with Special Reference to Sanitary Water Analysis. New York, John Wiley & Sons, 1904. pp. 162 + x. 8vo.

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C.-E. A. WINSLOW (with D. M. BELCHER).— Changes in the Bacterial Flora of Sewage during Storage. *Journal of Infectious Diseases*, Vol. I., No. 1, January, 1904.

C.-E. A. WINSLOW.— The Occurrence of the Colon Bacillus on the Hands. *Journal of Medical Research*, Vol. X., No. 3, December, 1903.

C.-E. A. WINSLOW.— The Sanitary Dangers of Certain Occupations. *Journal of the Massachusetts Association of Boards of Health*, Vol. XIV., No. 2, May, 1904.

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W. LYMAN UNDERWOOD.— Mosquitoes and Suggestions for their Extermination. Published for the General Board of Health of Bermuda, January, 1904.

E. E. LOCHRIDGE.— Chicago Drainage Canal Case. *Record of Evidence, Supreme Court of the United States, State of Missouri* vs. *The State of Illinois and the Sanitary District of Chicago*. Vol. VIII., pp. 7821–7955. Jefferson City, Mo., Tribune Publishing Company, 1904.

MINING ENGINEERING AND METALLURGY.

R. H. RICHARDS.— Notes on Mining, third year, first term. 264 pp. Published by the Institute.

R. H. RICHARDS.— Progress in Gold Milling during 1903. *The Mineral Industry*, Vol. XII., p. 159.

R. H. RICHARDS.— Review of the Literature on Ore-dressing in 1903. *The Mineral Industry*, Vol. XII., p. 397.

R. H. RICHARDS.— Mining Education. *Engineering and Mining Journal*, Vol. LXXVII., 1904, p. 836.

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R. W. LODGE.— Notes on Assaying and Metallurgical Laboratory Experiments. 279 pp. New York, John Wiley & Sons, 1904.

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G. LANZA.— A Brief Review of the Status of Testing in the United States. *Proceedings of the American Society for Testing Materials*, 1904.

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E. F. MILLER.— The Use of the Steam Engine Indicator for Other Work besides the Calculation of Horse-power. Crosby Steam Gage Company.

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W. O. CROSBY.— Memoir of Alpheus Hyatt. *Bulletin of the Geological Society of America*, Vol. XIV., pp. 504–514.

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W. O. CROSBY.— Geology of the Weston Aqueduct of the Metropolitan Water Works in Southboro, Framingham, Wayland, and Weston, Mass. *Technology Quarterly*, Vol. XVII., pp. 101–116.

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PHYSICS.

C. R. CROSS.— Article "Telephone." *Encyclopædia Britannica*, Vol. XXXIII.

H. M. GOODWIN.— Notes on Physical Laboratory Experiments. Heat. Second edition. Printed by the Institute.

H. M. GOODWIN.— The Electrochemical Laboratory of the Institute of Technology. *Electrochemical Industry*, Vol. II., p. 264, 1904. (See also Publications of Research Laboratory of Physical Chemistry).

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tion of Theatres. Report No. 14, Insurance Engineering Experiment Station.

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GEORGE F. SWAIN.— Reports to the Massachusetts Board of Railroad Commissioners on Railroad and Street Railway Bridges in Massachusetts. (Annual Report of the Board, January, 1904.)

C. FRANK ALLEN.— The Outlook for Engineering Education (Presidential address at meeting of Society for the Promotion of Engineering Education).

ALFRED E. BURTON — The Duties of the Dean of the Faculty at the Massachusetts Institute of Technology (Paper read before the Society for Promotion of Education in Chicago).

NAVAL ARCHITECTURE.

C. H. PEABODY.— Naval Architecture. New York, John Wiley & Sons, 1904.

W. HOVGAARD.— Water-tight Subdivision of War-ships. A paper presented to the Society of Naval Architecture and Marine Engineers. Published by the Society from 12 West 31st Street, New York, N.Y.

W. S. LELAND.— Displacement and Stability Calculation. A paper presented to the Society of Naval Architecture and Marine Engineers. Published by the Society from 12 West 31st Street, New York, N.Y.

MATHEMATICS.

C. M. MASON.— On Green's Theorem and Green's Functions for Certain Systems of Differential Equations, *Transactions of the American Mathematical Society.*

C. M. MASON.— Zur Theorie der Randwertaufgaben. *Mathematische Annalen.*

ELECTRICAL ENGINEERING.

H. E. CLIFFORD.— The Augustus Lowell Laboratories of Electrical Engineering. *Technology Review*, Vol. VI., p. 1.

Statistics.

THE CORPS OF INSTRUCTORS.

The Catalogue of this year shows the number of instructors of all grades to be 188, inclusive of those concerned with the mechanic arts, but exclusive of those who are announced as lecturers for the year only. The addition of these raises the total to 221. This year's Catalogue will show a decrease of eight in the number of lecturers and some changes in the grades of professors and instructors. Without counting lecturers, the number of instructors to that of students bears the proportion of one to eight and three-tenths. The following table shows the distribution among the several classes of instructors, in comparison with last year: —

	1903–04.		1904–05	
Professors	30		28	
Associate Professors	14		18	
Assistant Professors	25		19	
		69		65
Instructors	66		67	
Assistants	51		56	
		117		123
Lecturers	41	41	33	33
Total		227		221

STUDENTS AND GRADUATES.

The registration of this year, as shown by the Catalogue, amounts to 1,561. The following table shows the registration of successive years from the foundation of the Institute: —

Year.	No. of Students.	Year.	No. of Students.
1865–66	72	1885–86	609
1866–67	137	1886–87	637
1867–68	167	1887–88	720
1868–69	172	1888–89	827
1869–70	206	1889–90	909
1870–71	224	1890–91	937
1871–72	261	1891–92	1,011
1872–73	348	1892–93	1,060
1873–74	276	1893–94	1,157
1874–75	248	1894–95	1,183
1875–76	255	1895–96	1,187
1876–77	215	1896–97	1,198
1877–78	194	1897–98	1,198
1878–79	188	1898–99	1,171
1879–80	203	1899–1900	1,178
1880–81	253	1900–1901	1,277
1881–82	302	1901–1902	1,415
1882–83	368	1902–1903	1,608
1883–84	443	1903–1904	1,528
1884–85	579	1904–1905	1,561

STUDENTS BY CLASSES.

The aggregate number of students for 1904–05 is divided among the several classes, as follows: —

Fellows	11
Graduate students, candidates for advanced degrees	21
Regular students, Fourth Year	228
" " Third "	261
" " Second "	192
" " First "	298
Special students	550
Total	1,561

Assigning the special students to classes, according to the predominant studies pursued by them, we reach the following division of the whole body among the several years: —

Class.	Regular.	Special.	Total.
Fellows and Graduates of the M.I.T.	32	—	32
Fourth Year	228	115	343
Third Year	261	164	425
Second Year	192	169	361
First Year	298	102	400
Total	1,011	550	1,561

THE COURSES OF INSTRUCTION.

The following table presents the number of the regular students in the second, third, and fourth years, by courses: —

Year.	Civil Engineering.	Mechanical Engineering.	Mining Engineering and Metallurgy.	Architecture.	Chemistry.	Electrical Engineering.	Biology.	Physics.	General Course.	Chemical Engineering.	Sanitary Engineering.	Geology.	Naval Architecture.	Total.
4th Year Class .	52	51	24	10	19	29	3	2	–	11	7	–	20	228
3d " "	39	72	36	16	15	38	–	4	–	11	6	1	23	261
2d " "	49	35	17	15	12	31	1	7	–	10	9	–	6	192
Total	140	158	77	41	46	98	4	13	–	32	22	1	49	681

The following table shows the figures of the total line in the foregoing table, in comparison with the corresponding figures for the next ten preceding years: —

Year.	Civil Engineering.	Mechanical Engineering.	Mining Engineering and Metallurgy.	Architecture.	Chemistry.	Electrical Engineering.	Biology.	Physics.	General Course.	Chemical Engineering.	Sanitary Engineering.	Geology.	Naval Architecture.	Total.
1894	88	111	19	48	50	137	5	9	19	35	13	1	20	556
1895	88	118	25	67	59	126	7	11	14	25	10	3	22	575*
1896	99	117	24	65	66	106	7	11	11	34	8	-	25	573*
1897	109	119	38	71	60	90	8	9	10	36	7	1	26	578
1898	93	108	52	64	64	94	6	8	12	38	7	1	33	574
1899	99	113	60	53	58	84	8	7	11	30	14	1	38	575*
1900	89	127	69	53	50	87	6	4	8	34	17	1	38	582
1901	102	129	76	40	35	96	6	13	9	30	14	1	39	590
1902	129	133	83	43	58	118	2	20	9	30	12	1	65	703
1903	132	161	91	53	55	126	4	23	6	27	14	1	72	765
1904	140	158	77	41	46	98	4	13	—	32	22	1	49	681

The following table shows, by classes and by courses, the number of regular students who have registered themselves as electing to distribute the required studies and exercises over the period of five years: —

* Deducting those counted twice.

Year.	Total.	Course.												
		I.	II.	III.	IV.	V.	VI.	VII.	VIII.	IX.	X.	XI.	XII.	XIII.
1st . . .	4	–	–	–	–	–	–	–	–	–	–	–	–	–
2d . . .	5	2	3	–	–	–	–	–	–	–	–	–	–	–
3d . . .	12	2	5	–	–	–	2	–	–	–	2	–	1	–
4th . . .	8	3	3	–	1	–	1	–	–	–	–	–	–	–
5th . . .	5	1	3	–	–	–	–	–	–	–	–	1	–	–
	34	8	14	–	1	–	3	–	–	–	2	1	1	–

The following is the number of students, either regular or special, pursuing certain leading branches of study, in each of the four years: —

	First Year.	Second Year.	Third Year.	Fourth Year.	Total.
Mathematics	410	341	236	3	990
Chemistry	407	94	111	104	716
English	374	282	9	7	672
French	256	–	86	–	342
Physics	–	356	407	117	880
German	174	103	113	2	392
Mechanic Arts . . .	–	145	81	115	341

The total registration in the Sumner School was 233 students as compared with 258 in 1903: the registration in the various subjects is shown in the following table: —

	1904.
Mathematics.	
Analytic Geometry	28
Integral Calculus	12
Applied Mechanics	22
Mechanical Drawing and Descriptive Geometry . . .	23
Mechanic Arts (Shopwork).	
Forging	16
Chipping and Filing	12
Machine-Tool Work	31
Wood Work (120, 122, 123)	8

Modern Languages.
- French 15
- German 10

Chemistry.
- Inorganic and Analytical Chemistry (550, 551, 552, 558, 559) 39
- Air, Water, and Food Analysis 6
- Organic Chemistry (596, 598) 9

Physics.
- Mechanics, Light, and Electricity 40
- Heat 6
- Physical Laboratory 7

Civil Engineering.
- Surveying 5

Mechanical Engineering.
- Mechanism 12

NOTE.— Numbers immediately following certain subjects refer to the subject numbers used in the current Catalogue.

RESIDENCE OF STUDENTS.

States.	Candidates for Advanced Degrees.	Fourth Year.	Third Year.	Second Year.	First Year.	All Regular Students.	Special Students.	Total.
Alabama	–	–	–	–	–	–	1	1
California	1	1	3	4	1	10	5	15
Colorado	–	1	6	2	–	9	–	9
Connecticut	1	7	6	5	13	32	13	45
Delaware	–	2	–	–	–	2	–	2
Dist. of Columbia	3	1	4	2	2	12	5	17
Florida	–	–	–	1	1	2	2	4
Georgia	–	–	1	–	–	1	5	6
Hawaii	–	–	–	–	–	–	1	1
Illinois	2	5	5	5	3	20	23	43
Indiana	1	2	2	–	2	7	3	10
Iowa	–	1	1	–	3	5	4	9
Kansas	–	1	1	–	1	3	1	4
Kentucky	–	4	–	–	1	5	3	8
Louisiana	1	–	–	–	–	1	4	5
Maine	–	6	7	3	4	20	6	26
Maryland	–	3	2	3	4	12	6	18
Massachusetts	13	132	149	122	215	631	258	889
Michigan	1	2	–	–	1	4	5	9
Minnesota	–	–	1	1	–	2	9	11
Mississippi	–	–	–	3	–	3	1	4
Missouri	–	2	5	1	3	11	14	25
Montana	–	–	–	–	2	2	3	5
Nebraska	–	1	–	1	1	3	2	5
New Hampshire	1	6	7	3	6	23	13	36
New Jersey	–	1	4	1	2	8	8	16
New Mexico	–	1	1	–	–	2	–	2
New York	2	20	15	11	8	56	38	94
North Carolina	–	1	–	–	–	1	–	1
North Dakota	–	–	–	–	1	1	–	1
Ohio	3	6	8	4	–	21	14	35
Oregon	–	2	3	–	–	5	3	8
Pennsylvania	1	5	7	12	6	31	25	56
Philippine Islands	–	–	–	–	–	–	4	4
Porto Rico	–	–	1	–	1	2	2	4
Rhode Island	–	2	5	1	5	13	6	19
South Dakota	–	1	–	–	–	1	1	2
Tennessee	1	–	–	–	–	1	1	2
Texas	–	1	1	3	–	5	8	13
Utah	–	1	–	–	–	1	2	3
Vermont	–	–	3	–	–	3	2	5
Virginia	–	–	3	–	1	4	–	4
Washington	–	–	1	–	–	1	1	2
Wisconsin	1	2	6	1	2	12	2	14
Foreign Countries.								
Armenia	–	–	–	–	–	–	1	1
Australia	–	–	–	–	–	–	1	1
Brazil	–	–	1	–	–	1	2	3
Central America	–	–	–	–	1	1	1	2
Chili	–	–	–	–	–	–	1	1
China	–	1	–	–	–	1	7	8
Cuba	–	–	1	–	–	1	3	4
Denmark	–	–	–	–	1	1	–	1
Ecuador	–	–	–	–	–	–	1	1
England	–	2	–	–	1	3	1	4
France	–	–	–	1	–	1	–	1
India	–	–	–	–	–	–	1	1
Jamaica	–	–	–	–	–	–	1	1
Japan	–	–	–	–	–	–	1	1
Korea	–	–	–	–	2	2	–	2
Malta, Island of	–	–	–	1	–	1	–	1
Mexico	–	1	–	–	1	2	2	4
New Brunswick	–	–	–	–	2	2	1	3
Nova Scotia	–	2	1	–	–	3	1	4
Ontario	–	1	–	–	2	3	2	5
Quebec	–	–	–	–	2	2	–	2
Scotland	–	–	–	1	–	1	1	2
Sweden	–	–	–	–	–	–	1	1
Syria	–	1	–	–	–	1	–	1
Transvaal	–	–	–	–	–	–	1	1
Turkey	–	–	–	1	–	1	1	2
Total	32	228	261	192	298	1,011	550	1,561

Forty states of the Union and two territories, besides the District of Columbia, Porto Rico and the Philippine Islands, are represented on our list of students. Of the total number of 1,561, 889 are from Massachusetts, or 58 per cent. of the whole; 134 are from other New England states; 478 are from outside New England. Of these 60 are from foreign countries.

A table showing the number of students in each year, from 1898, coming from each state or territory, and from

each foreign country, may be not without interest and instruction: —

States.	1898.	1899.	1900.	1901.	1902.	1903.	1904.
Alabama	1	–	1	2	1	1	1
Arkansas	–	–	1	1	1	1	–
California	11	9	10	9	15	19	18
Colorado	8	7	8	6	10	11	16
Connecticut	26	29	35	42	43	44	48
Delaware	3	4	4	3	4	3	2
Dist. of Columbia	8	7	13	14	17	15	17
Florida	–	1	1	1	2	2	4
Georgia	4	3	3	4	6	4	6
Hawaiian Islands	1	–	1	–	–	1	1
Idaho	–	–	–	1	–	–	–
Illinois	51	36	39	44	49	44	43
Indiana	3	5	7	11	14	6	10
Iowa	7	6	10	8	8	6	9
Kansas	–	–	–	1	1	1	4
Kentucky	10	4	5	9	11	9	8
Louisiana	1	1	2	1	2	2	5
Maine	19	25	22	30	35	34	26
Maryland	8	8	13	16	27	25	18
Massachusetts	719	731	770	837	935	869	889
Michigan	9	10	8	12	10	9	9
Minnesota	11	10	7	10	10	9	11
Mississippi	–	–	–	–	–	4	4
Missouri	10	11	13	19	20	22	25
Montana	2	3	5	4	3	2	5
Nebraska	1	3	4	3	5	4	5
Nevada	–	1	1	–	–	–	–
New Hampshire	25	29	26	31	34	23	36
New Jersey	13	12	8	6	8	13	16
New Mexico	–	–	–	–	1	1	2
New York	68	61	68	79	96	104	94
North Carolina	2	2	2	6	6	7	1
North Dakota	–	–	–	–	1	1	1
Ohio	23	27	27	27	43	37	35
Oregon	3	2	1	2	4	7	8
Pennsylvania	34	33	37	36	44	52	56
Philippine Islands	–	–	–	–	–	–	4
Porto Rico	–	–	–	1	2	2	4
Rhode Island	23	32	35	38	40	28	19
South Carolina	1	1	1	2	4	–	–
South Dakota	–	1	1	2	1	3	2
Tennessee	3	4	6	4	3	5	2
Texas	1	2	4	7	9	11	13
Utah	5	6	7	7	2	3	3
Vermont	12	12	15	15	12	11	5
Virginia	3	2	3	5	7	7	4
Washington	7	4	2	4	3	3	2
West Virginia	–	1	1	1	–	–	–
Wisconsin	8	7	8	11	11	13	14
Wyoming	–	–	–	–	1	–	–
Foreign Countries.							
Armenia	–	–	–	–	–	1	1
Australia	–	–	–	–	2	3	1
Austria	–	–	–	1	–	–	–
Bermuda	–	–	1	2	1	1	–
Brazil	–	–	–	4	5	3	3
Cape Breton	1	–	–	–	–	–	–
Central America	–	–	–	–	–	–	1
Chili	–	–	–	1	1	1	1
China	–	–	–	1	1	2	8
Cuba	1	–	–	1	2	3	4
Denmark	1	1	1	1	1	1	1
Dutch Guiana	1	1	–	–	–	–	–
Ecuador	–	–	–	–	–	–	1
England	4	1	3	3	3	4	4
France	1	2	4	1	–	–	1
Germany	1	1	2	3	1	2	–
India	–	–	–	–	–	1	1
Ireland	–	–	–	–	1	1	–
Jamaica	–	1	1	1	–	–	1
Japan	1	2	2	2	1	2	1
Korea	–	–	–	–	–	–	2
Malta, Island of	–	–	–	–	–	1	1
Manitoba	–	–	–	–	1	1	–
Mexico	7	7	7	7	10	8	4
New Brunswick	3	3	2	2	2	1	2
Nova Scotia	2	–	2	6	8	9	4
Ontario	–	–	–	3	2	2	5
Quebec	1	3	4	2	–	1	2
Russia	–	1	1	1	–	–	–
Scotland	–	–	–	–	1	1	2
Sweden	–	–	–	–	–	–	1
Syria	–	–	–	–	–	1	1
Transvaal	–	–	–	–	–	–	1
Turkey	3	3	3	1	4	–	2
Total	1,171	1,178	1,277	1,415	1,608	1,528	1,561

RESIDENCE OF MASSACHUSETTS STUDENTS.

It has been said that 58 per cent. of our students are from Massachusetts. All the counties of the State except Nantucket send students to the Institute. One hundred and forty-six cities and towns are on the lists. The first column of the following table shows the number of cities and towns in each

county sending pupils: the second column gives the aggregate number from each county. It appears that Middlesex sends two hundred and seventy-four and Suffolk two hundred and fifty-five pupils; Essex comes third, with one hundred and twenty-six; Norfolk, fourth, with eighty-one.

County.	No. of Towns.	No. of Students.	County.	No. of Towns.	No. of Students.
Barnstable	4	6	Hampshire . . .	2	5
Berkshire	5	13	Middlesex . . .	34	274
Bristol	12	38	Norfolk	18	81
Dukes	1	2	Plymouth	16	27
Essex	26	128	Suffolk	4	255
Franklin	4	6	Worcester . . .	15	35
Hampden	5	19			
			Total	146	889

The following is a list of the towns, forty-two in number, which send five or more students to the Institute: —

Boston	239	New Bedford .	12	Peabody . . .	7
Newton	45	Taunton . . .	12	Winchester . .	7
Cambridge . . .	29	Hyde Park . .	11	Andover . . .	6
Malden	26	Haverhill . .	10	Arlington . .	6
Somerville . . .	25	Wakefield . .	10	Milton . . .	6
Brookline . . .	19	Beverly . . .	9	Woburn . . .	6
Lowell	19	Medford . . .	9	Brockton . .	5
Waltham . . .	19	Springfield . .	9	Canton . . .	5
Lawrence . . .	17	Chelsea . . .	8	Holyoke . . .	5
Newburyport . .	16	Quincy . . .	8	Marlboro . .	5
Framingham . .	13	Belmont . . .	7	Pittsfield . . .	5
Lynn	13	Fitchburg . .	7	Revere . . .	5
Salem	13	Gloucester . .	7	Weymouth . .	5
Melrose	12	Milford . . .	7	Worcester . .	5

The following table exhibits for ten years the distribution of the total number of students among two classes: first, those students whose names are found upon the Catalogue of the year preceding; and, secondly, those whose names appear first upon the Catalogue of the year to which the statement relates.

Year.	(1) Total No. of Students.	(2) No. of Students in the catalogue of the previous year who remain in the Institute.	(3) No. of New Students entering before issue of catalogue.	(4) Of those in column (3) the following number are regular First-year Students.	(5) No. of New Students not of the regular First-year Class.
1893-94	1,157	701	456	301	155
1894-95	1,183	768	415	271	144
1895-96	1,187	778	409	266	143
1896-97	1,198	758	440	263	177
1897-98	1,198	757	441	277	164
1898-99	1,171	769	402	278	124
1899-1900	1,178	764	414	275	139
1900-1901	1,277	789	488	312	176
1901-1902	1,415	844	571	396	175
1902-1903	1,608	949	659	432	226
1903-1904	1,528	1,042	486	249	237
1904-1905	1,561	986	575	295	280

AGES OF STUDENTS.

The next table exhibits the ages of our students upon entrance, after taking out five who are repeating the first year, and nine persons of unusual ages. These deductions leave two hundred and eighty-four as the number of students whose ages have been made the subject of computation.

Period of Life.	1903-1904		1904-1905.	
	Half-year Groups.	Yearly Groups.	Half-year Groups.	Yearly Groups.
16 to 16½ years	1	—	1	—
16½ to 17 "	9	10	8	9
17 to 17½ "	13	—	22	—
17½ to 18 "	38	51	40	62
18 to 18½ "	50	—	47	—
18½ to 19 "	38	88	51	98
19 to 19½ "	31	—	41	—
19½ to 20 "	34	65	40	81
20 to 20½ "	14	—	15	—
20½ to 21 "	8	22	10	25
21 to 22 "	9	9	9	9
	245	245	284	284

The results appear in the table above in comparison with the corresponding results of 1903–04.

From the foregoing it appears that the average age on entrance is eighteen years and nine months.

In this connection are presented the ages, at graduation, of the class which left us in June. The two hundred and thirty-two members of the class were distributed among the different periods of life as follows: —

Under 20½	1
Between 20½ and 21	8
" 21 " 21½	10
" 21½ " 22	28
" 22 " 23	75
" 23 " 24	45
" 24 and over	65
Total	232

The special students this year constitute thirty-five per cent. of the whole body, as against thirty-two per cent. last year and twenty-eight per cent. the year before.

GRADUATE STUDENTS.

The number of students who are graduates of this and other institutions is one hundred and eighty-two. Of these thirty-two are candidates for advanced degrees, eighteen being our own graduates.

One hundred and fifty are graduates of the following institutions, and are pursuing undergraduate courses of study with us either as regular or as special students.

Universities.

Boston	1	Missouri	1
Brown	1	Ohio State	1
California	1	Pennsylvania	4
Chicago	2	Porto Rico	1
Columbia	1	Princeton	9
Cornell	1	Rochester	4
Denison	1	Saint Louis	2
De Pauw	1	Southwestern	1
Georgetown	2	Syracuse	1
Hamline	1	Texas	1
Harvard	19	Tulane	1
Indiana	1	Vermont	1
Johns Hopkins	2	Washington and Lee	3
Kansas State	2	Washington State	1
Lehigh	1	Wesleyan	1
Louisiana	1	Western Reserve	1
Maine	1	Wooster	1
Mercer	1	Yale	1
Minnesota	1		

Colleges.

Amherst	4	New Hampshire	1
Anatolia	1	New Mexico	1
Bates	1	Oberlin	1
Beloit	4	Rock Hill	1
Bethany	1	Sacred Heart	1
Boston	1	Saint Ignatius	1
Bowdoin	1	Saint Stanislaus	1
Butler	1	Saint Vincent	1
Canisius	1	Saint Francis Xavier	1
Case School of Applied Science	2	Smith	1
Centenary	1	Syrian Protestant	1
Central	1	Texas Agricultural	1
Coe	1	Trinity	2
Colby	3	U. S. Naval Academy	20
Connecticut Agricultural	1	Wabash	1
Dartmouth	4	Washington and Jefferson	1
Davidson	1	Wellesley	1
Delaware	1	Westminster	1
Hamilton	1	Williams	2
Holy Cross	1	Wittenburg	1
Iowa State	1	Worcester Polytechnic	1
Kansas State	1	Yankton	1
Kentucky State	1		100
Massachusetts Institute of Technology	18		
Middlebury	1		
Milton	1	Total	186
Mount Allison	1	Deduct names counted twice	4
Mount Holyoke	1		182

WOMEN STUDENTS.

The number of women pursuing courses with us is twenty-nine. Of these six are graduates of colleges. Of the total number five are regular students of the third year, three of the second, and one of the first year. Twenty are special students. Of the eight regular students of the upper classes one takes Course II., Mechanical Engineering; three take Course IV., Architecture; three, Course V., Chemistry; and one, Course XII., Geology. Of the special students, four devote themselves to architecture, nine to biology, one to chemistry, and one to physics, while three are first-year students.

STATISTICS OF ADMISSION.

Of the 1,561 students of the present year, 575 were not connected with the school in 1903–04. Of these 277 were admitted as regular students of the first year upon the basis of their entrance examinations. The 298 remaining comprise (1) those who had previously been connected with the Institute, and have resumed their places in the school; (2) those

who were admitted provisionally without examinations; (3) those who were admitted by examination as regular second-year or as special students; (4) those who were admitted on the presentation of diplomas or certificates from other institutions of college grade. In addition to the 277 who were thus admitted to the first year on examination, and have taken their place in the school, 71 were admitted on examination, but have not entered the school.

In the case of the 277 persons who were admitted on examination, and have joined the school, the results of the examinations, embracing both those of June and those of September, were as follows: —

Admitted clear	185
" on one condition	66
" on two conditions	22
" on three conditions	4
	277

Of the 761 persons who presented themselves in June for examination, 37 Complete, 10 Final, 88 Preliminary, and 24 Partial candidates, a total of 159, were rejected. In September 15 Complete, 5 Final, and 13 Preliminary candidates were rejected. 271 attended the September examinations.

GRADUATES BY COURSES.

The following table exhibits the number of persons who have received the Bachelor's Degree in each of the several courses since the foundation of the school: —

Year.	Civil Engineering.	Mechanical Engineering.	Mining Engineering.	Architecture.	Chemistry.	Metallurgy.	Electrical Engineering.	Natural History or Biology.	Physics.	General Course.	Chemical Engineering.	Sanitary Engineering.	Geology.	Naval Architecture.	Total.
1868	6	1	6	–	–	–	–	–	–	1	–	–	–	–	14
1869	2	2	–	–	1	–	–	–	–	–	–	–	–	–	5
1870	4	2	2	–	1	–	–	–	–	1	–	–	–	–	10
1871	8	2	5	–	2	–	–	–	–	–	–	–	–	–	17
1872	3	1	5	–	3	–	–	–	–	–	–	–	–	–	12
1873	12	2	3	1	7	–	–	–	–	1	–	–	–	–	26
1874	10	4	1	1	–	–	–	–	–	2	–	–	–	–	18
1875	10	7	6	1	1	–	–	–	1	2	–	–	–	–	28
1876	12	8	7	–	5	1	–	2	3	4	–	–	–	–	42
1877	12	6	8	4	2	–	–	–	–	–	–	–	–	–	32
1878	8	2	2	3	3	–	–	–	–	1	–	–	–	–	19
1879	6	8	3	1	3	–	–	1	1	–	–	–	–	–	23
1880	3	–	3	–	1	–	–	–	–	1	–	–	–	–	8
1881	3	5	6	3	8	–	–	1	–	2	–	–	–	–	28
1882	2	5	5	3	6	–	–	1	1	1	–	–	–	–	24
1883	3	7	5	1	3	–	–	–	–	–	–	–	–	–	19
1884	5	6	13	–	12	–	–	–	–	–	–	–	–	–	36
1885	4	7	8	2	4	–	2	–	–	1	–	–	–	–	28
1886	9	23	7	1	7	–	10	1	–	1	–	–	–	–	59
1887	10	17	8	1	9	–	8	1	1	3	–	–	–	–	58
1888	11	25	4	5	10	–	17	3	1	1	–	–	–	–	77
1889	14	24	5	3	8	–	17	1	1	2	–	–	–	–	75
1890	25	28	3	5	13	–	18	3	2	6	–	–	–	–	103
1891	18	26	4	6	11	–	23	3	3	1	7	–	1	–	103
1892	22	26	4	13	7	–	36	6	1	7	4	6	1	–	133
1893	25	30	5	2	8	–	41	2	–	6	8	–	2	–	129
1894	21	31	4	14	11	–	33	1	3	5	12	3	–	–	138
1895	25	30	3	15	14	–	33	–	2	4	11	4	–	5	144*
1896	26	34	10	24	17	–	48	3	3	7	7	4	3	5	190*
1897	25	40	7	16	20	–	33	2	3	7	12	4	1	9	179
1898	32	41	7	29	25	–	33	3	4	6	9	3	–	7	199
1899	30	37	9	22	22	–	32	2	2	1	10	1	–	8	173*
1900	32	34	21	21	19	–	23	3	3	5	11	4	–	9	185
1901	37	39	18	21	17	–	25	1	1	6	14	4	1	16	200
1902	24	46	14	18	14	–	35	5	3	3	9	7	–	14	192
1903	26	37	27	15	13	–	39	1	4	1	10	4	1	12	190
1904	34	45	32	24	15	–	34	3	13	5	7	2	1	17	232
Totals	549	688	280	275	325	1	540	49	56	93*	131	46	11	102	3,148*
Deduct names counted twice															16
Net total															3,132*

* Deducting names counted twice.

GENERAL STATEMENT

OF THE

RECEIPTS AND DISBURSEMENTS

BY THE TREASURER

FOR THE YEAR ENDING SEPT. 30, 1904

STATEMENT OF THE TREASURER.

The Treasurer submits the annual statement of the financial affairs of the Institute for the year ending September 30, 1904.

The increase in the tuition fees went into effect at the beginning of the year, so far as regarded the first-year students, and the result is shown in increased receipts from that source, such increase amounting to nearly $11,000.

Throughout the year strict economy has been practised in the expenditures, and in certain items considerable savings have been made. The cost of repairs has been less than the year before by about $4,000. General expenses have been reduced about $12,000, and there has been a saving of more than $6,000 in the cost of fuel.

These savings were more than offset by an increase of expenses in other matters. The expenditure for Department Supplies has increased about $16,000. Catalogues and reports have cost about $2,300 more than the previous year, and fire insurance has increased by about $600. The Society of Arts has cost about $1,600 more than the year before, and the St. Louis Exposition has added to our expenses about $3,300. The deficit has been increased by the fact that the receipts for laboratory supplies and breakages have been about $4,000 less. There have been, moreover, the following special expenditures: for equipment for the Electrical Engineering Building, about $20,000; and for the building known as Engineering Building C, about $9,500. Payments for salaries and labor have been much larger than during the previous year. The expenditures for the Electrical Engineering Building and for Engineering Building C are not included in our current expenses, but, even so, there is a deficit in the current expense account for the year of more than $55,000. This, however, is accounted for in part by the payment of about $9,000 for the equipment and maintenance of the Physico-Chemical Research Laboratory, this sum being in addition to about $5,000 paid from gifts for that special purpose, and also by the expenditure of $3,000 for a dynamo plant in the Department of Physics and $4,200 for Electro-Chemical equipment. The increased charge for printing catalogues and reports is due in part to the fact that many of these were printed for distribution at the St. Louis Exposition.

During the year the following legacies and gifts have been received: —

From the Arioch Wentworth Estate, $100,000.

From the Charles C. Nichols estate, $5,000 to constitute the Charles C. Nichols Fund.

From the same friend who has heretofore paid the expenses of the Sanitary Research Laboratory an additional $5,000 for the same purpose.

From Theodore E. Russel, Esq., $2,000 to form the Richard Lee Russel Fellowship.

From the Estate of Susan E. Dorr, $1,476.94, to be added to the Susan E. Dorr Fund.

Other gifts have amounted to between five and six thousand dollars, of which Professor A. A. Noyes gave $3,000 to aid the Physico-Chemical

Research Laboratory. One friend of the Institute contributed $1,000 for general purposes, and another $500 for salaries. General Charles J. Paine gave $421.73 for the department of Naval Architecture, Mrs. William B. Rogers $200 for the purchase of periodicals, and Mr. Samuel Cabot $200 for the Physico-Chemical Research Laboratory. Gifts have also been received from Charles G. Weld, Esq., and another friend.

Additional subscriptions to the Walker Memorial Fund have been paid, amounting to $7,500; and the whole fund, including accrued income, is now $94,890.45.

After deducting the deficit in the current expense account, there remains a net increase in the property of the Institute amounting nominally to $68,014.69, about $15,000 of which is made up of students' fees paid in advance.

Securities Sold or Paid, General Fund.

$35,000	Fitchburg R.R. 5s	1903	$35,000.00
26,000	New York & New England R.R. 6s	1905	26,390.00
2,000	New York & New England R.R. 7s	1905	2,050.00
1,000	Bur. & Mo. River R.R. non-ex. 6s	1918	1,000.00
1,000	Ozark Equipment Co. 5s	1910	1,000.00
			$65,440.00

Securities Sold or Paid, Rogers Memorial Fund.

30,000	Bur. & Mo. River R.R. 4s	1910	30,000.00
6,000	New York & New England R.R. 6s	1905	6,090.00
			$36,090.00

Securities Bought or Received as Legacies, General Fund.

34,000	Baltimore & Ohio R.R. 3½s	1925	30,090.00
30,000	Chi., Mil. & St. Paul R.R. 7s.	1910	35,100.00
52,000	N.Y. Cent. & H. R. R.R. (L. S.) 3½s	1998	46,046.65
5,000	American Tel. & Tel. Co. 5s	1907	5,012.50
			$116,249.15

Rogers Memorial Fund.

6,000	Baltimore & Ohio R.R. 3½s	1925	5,310.00
31,000	N.Y. Cent. & H. R. R.R. Deb. 4s	1934	30,225.00
			$35,535.00

Richard Lee Russel Fund.

2,000	Conv. Title Ins. Co. Mortgage 4s	1908	$2,000.00

GEORGE WIGGLESWORTH, TREASURER, *in account with*
GENERAL STATEMENT OF RECEIPTS AND DISBURSEMENTS

Dr.

Cash balance, Sept. 30, 1903		5,545.71
RECEIPTS FOR CURRENT EXPENSES.		
Income of funds for salaries	4,324.00	
" " " " Savage Fellowship	400.00	
" " " " scholarships (students' fees),	10,675.00	
" " " " Joy "	200.00	
" " " " W. B. Rogers Scholarships,	500.00	
" " " " Library	480.00	
" " " " general purposes	26,235.12	
" " Rogers Memorial Fund	10,610.11	
" " Charlotte B. Richardson Fund	1,495.15	
" " Rotch Prize Funds	400.00	
" " Rotch Architectural Fund	1,000.00	
" " Edward Austin Fund, Scholarships	6,737.50	
" " " " " Awards	3,387.50	
" " Teachers' Fund	3,400.00	
Letter Box Fund	50.00	
Students' fees	297,344.25	
State Scholarships	4,000.00	
United States Act of 1862	6,293.06	
United States Act of 1890	8,333.34	
Gift of State of Massachusetts	25,000.00	
Laboratory supplies and breakages	11,925.99	
Rents, per Table (page 12)	10,348.81	
Gifts	2,394.15	
Interest	3.410.38	
Boston University	2,650.00	
Sale Printed Lecture Notes	4,461.15	446,055.51
GIFTS AND BEQUESTS FOR SPECIAL PURPOSES.		
Increase Scholarship Funds	728.11	
" Teachers' Fund	600.00	
" Edward Austin Fund	4,275.00	
" Susan E. Dorr Fund, additional	1,476.94	
" Joy Scholarship Fund	1,222.61	
Richard Lee Russel Fellowship Fund	2,000.00	
Charles C. Nichols Fund	5,000.00	15,302.66
GIFTS AND BEQUESTS FOR GENERAL PURPOSES.		
Arioch Wentworth Legacy		100,000.00
SECURITIES SOLD OR PAID.		
General Fund, page 3		65,440.00
Rogers Memorial Fund, page 3		36,090.00
SUNDRIES.		
Income credited to Bond Premium Acc't	3,737.50	
" " " Rogers Bond Premium Acc't,	788.00	
Copley Society of Boston, on acc't	666.68	
Walker Memorial Fund	14,841.85	
Sanitary Research Laboratory Fund, additional	5,000.00	
Physico-Chem. Research Fund	3,000.00	
Notes Receivable	25,000.00	
Students' Notes	7.25	
Acc'ts Payable and Fees paid in advance	17,206.06	70,247.34
		$738,681.22

MASSACHUSETTS INSTITUTE OF TECHNOLOGY.

FOR THE YEAR ENDING SEPT. 30, 1904.

Cr.

EXPENSES.

Salaries, per Table (page 12)	340,649.43	
Fellowship paid from Savage Fund	400.00	
" " " Dalton Grad. Chem. Fund,	500.00	
Edward Austin Fund, Awards	3,387.50	
Teachers' Fund "	3,400.00	
Prizes, Rotch Funds	400.00	
Repairs, per Table (page 13)	11,911.07	
General Expenses, per Table (page 13)	17,822.45	
Fire Insurance	4,786.43	
Fuel	18,943.12	
Water	3,470.10	
Gas	2,652.10	
Electricity	2,020.93	
Printing and Advertising	7,552.61	
" Lecture Notes	3,139.24	
" Annual Catalogues and Reports	6,107.64	
Physico-Chemical Research Fund	3,000.00	
Department Supplies, per Table (p. 12),	66,269.94	
Society of Arts	1,775.62	
St. Louis Exposition	3,272.99	501,461.17

(Expenses more than Income, $55,405.66)

SECURITIES BOUGHT OR RECEIVED AS LEGACIES.

General Fund, page 3		116,249.15
Rogers Mem. Fund, page 3		35,535.00
Richard Lee Russel Fund, page 3		2,000.00
Joy Fund, interest deposited		1,222.61

SUNDRIES.

Aug. Lowell Lab. Electrical Eng. Bldg., 1902	48.98	
Equipment Electrical Engineering Building	19,854.55	
Engineering Building C	9,501.95	
Sanitary Research Laboratory Fund, expended	5,526.97	
Physico-Chem. Research Fund, expended	4,895.75	
Student Fund, expended	763.50	
Roentgen-Ray Fund, expended	18.50	
Students' Deposits	250.00	
Notes Payable	25,000.00	65,860.20
Cash balance Sept. 30, 1904		16,353.09
		$738,681.22

E. and O. E.

GEORGE WIGGLESWORTH,
Treasurer.

The following account exhibits the property held by the Institute, as per Treasurer's books, Sept. 30, 1904:—

INVESTMENT OF THE W. B. ROGERS MEMORIAL FUND.

31,000.00	N.Y. Central & H. R. R.R. Deb. 4s,	1934	30,225.00
6,000.00	Baltimore & Ohio R.R. 3½s . . .	1925	5,310.00
27,000.00	Kansas City Belt R.R. 6s	1916	27,000.00
3,800.00	Republican Valley R.R. 6s	1919	3,800.00
4,000.00	Cin., Ind., St. Louis & Chicago R.R. 6s,	1920	4,000.00
4,000.00	Kansas City, Fort Scott & Gulf R.R. 7s,	1908	4,000.00
1,000.00	Lincoln & Northwestern R.R. 7s . .	1910	1,000.00
1,000.00	Atchison & Nebraska R.R. 7s . .	1908	1,000.00
35,000.00	Fort Street Union Depot 4½s . . .	1941	34,825.00
24,000.00	Rome, Watertown & Ogdensburg R.R. 5s	1922	24,000.00
37,500.00	Detroit, G. Rapids & Western R.R. 4s,	1946	37,500.00
25,000.00	Atchison, Top. & St. Fé R.R. 4s .	1995	24,470.00
7,000.00	Chesapeake & Ohio R.R. 5s . . .	1939	7,000.00
38,000.00	Chi. Junc. & Union Stock Yards 5s .	1915	38,000.00
	Advances to Bond Premium acc't .		7,411.00
			249,541.00

INVESTMENTS, GENERAL ACCOUNT.

6,000.00	Bur. & Mo. River (Neb.) R.R. 6s, non-exempt	1918	6,000.00
2,000.00	Bur. & Mo. River (Neb.) R.R. 6s, exempt	1918	2,000.00
5,000.00	Chicago, Burlington & Quincy R.R. 4s	1922	4,100.00
3,000.00	Hannibal & St. Joseph R.R. 6s . .	1911	3,000.00
65,000.00	Boston & Maine R.R. 4½s	1944	65,000.00
26,000.00	Am. Dock & Improvement Co. 5s .	1921	26,000.00
3,000.00	Illinois Central R.R. 4s	1951	3,000.00
8,000.00	Chi. Junc. & Union S. Yards 5s . .	1915	8,000.00
5,000.00	Dominion Coal Co. 1st 6s	1913	5,000.00
2,000.00	New England Tel. & Tel. Co. 6s .	1907	2,000.00
100,000.00	West End Street Ry. 4s	1917	100,000.00
50,000.00	Utah & Northern R.R. 1st 7s . . .	1908	50,000.00
50,000.00	Chi. Terminal & Transfer Co. 1st 4s,	1947	47,507.50
120,000.00	Illinois Steel Co., non-conv. 5s . .	1913	119,586.25
43,000.00	Chesapeake & Ohio R.R. 5s . . .	1939	43,000.00
100,000.00	Long Island R.R. 4s	1949	96,137.50
7,000.00	K. C., Clinton & Springfield R.R. 5s,	1925	6,289.21
8,500.00	K. C., Mem. & Birmingham R.R. 4s,	1934	8,287.50
13,000.00	K. C., St. Jo. & Council Bluffs R.R. 7s	1907	13,000.00
50,000.00	Kansas City Stock Yards 5s . . .	1910	50,000.00
25,000.00	Atchison, Top. & St. Fé R.R. 4s .	1995	25,000.00
50,000.00	Rio Grande & Western R.R. 4s . .	1939	49,180.00
50,000.00	Oregon R.R. & Navigation Co. 4s,	1946	50,000.00
50,000.00	Union Pacific R.R. 4s	1947	50,000.00
100,000.00	Chic. & W. Michigan R.R. 5s . .	1921	100,000.00
100,000.00	American Tel. & Tel. Co. 4s . . .	1929	99,875.00
50,000.00	New England Tel. & Tel. Co. 4s .	1930	50,000.00
50,000.00	Chi. Junc. & Union S. Yards 4s . .	1940	49,250.00
50,000.00	K. C., Fort Scott & Memphis R.R. 6s	1928	50,000.00
25,000.00	Southern Ry., St. Louis Div. 4s . .	1951	24,875.00
17,000.00	Ozark Equipment Co. 5s	1910	17,000.00
50,000.00	Northern Pac. Gt. Northern Joint 4s.	1921	48,500.00
34,000.00	Baltimore & Ohio R.R. 3½s . . .	1925	30,090.00
30,000.00	Chi., Mil. & St. Paul R.R. 7s . . .	1910	30,000.00
52,000.00	N.Y. Cent. & H. R. R.R. (L. S.) 3½s,	1998	46,046.65
5,000.00	American Tel. & Tel. Co. 5s . . .	1907	5,000.00
	Advances to Bond Premium acc't		37,775.00
			1,420,499.61
	Amount carried up		$1,670,040.61

	Amount brought up				$1,670,040.61

STOCKS.

Shares.					
172	Boston & Albany R.R.	par	100	34,456.50	
80	Chi., Milwaukee & St. Paul R.R. Pf.	"	100	9,908.00	
12	Cocheco Manufacturing Co.	"	500	6,000.00	
56	Hamilton Woolen Co.	"	100	5,390.00	
31	Great Falls Manufacturing Co.	"	100	3,472.00	
2	Dwight Manufacturing Co.	"	500	1,600.00	
17	Pepperell Manufacturing Co.	"	100	2,789.50	
27	Essex Co.	"	50	3,780.00	
64	Boston Real Estate Trust	"	1000	68,909.64	
1	Boston Ground Rent Trust	"	1000	900.00	137,205.64

INVESTMENT OF THE JOY SCHOLARSHIP FUND.

	Massachusetts Hospital Life Insurance Co. .	5,000.00	
	Deposits in Savings Banks	5,346.31	10,346.31

INVESTMENT SWETT SCHOLARSHIP FUND.

	Massachusetts Hospital Life Insurance Co.	10,000.00

INVESTMENT OF RUSSEL FELLOWSHIP FUND.

2,000.00	Conveyancers Title Ins. Co. Mortgage 4s . .	1908	2,000.00
	Amount carried up		$1,829,592.56

Amount brought up			$1,829,592.56

REAL ESTATE.

Rogers Building		200,000.00	
Walker "		150,000.00	
Land on Garrison Street	50,840.00		
Mechanic Arts Building	30,000.00	80,840.00	
Land on Trinity Place	76,315.69		
Engineering Bldg. A, Trinity Place .	90,000.00	166,315.69	
Gymnasium Building		7,967.85	
Engineering Building, B		57,857.10	
Engineering Building, C		47,561.08	
Lot No. 2, Trinity Place		137,241.60	
Lot No. 3, " "		282,286.35	
Henry L. Pierce Building, Trinity Place . . .		154,297.05	
Boiler and Power House, " " . . .		26,916.74	
Clarendon St. Land and Building		142,762.94	
Real Estate, Massachusetts Ave., Cambridge .		16,154.38	
Real Estate, Brookline, Mass.		112,964.32	
Aug. Lowell Lab. Elec. Eng. Bldg., 1902 . . .		121,790.93	1,704,956.03
Equipment, Engineering Building		16,555.24	
" Mechanical Laboratories		20,628.56	
" Elec. Eng. Building		86,550.15	123,733.95

SUNDRIES.

Notes Receivable		12,000.00	
Loans to Copley Society of Boston		7,666.65	
Students' Notes		763.25	
Cash Balance, Sept. 30, 1904		16,353.09	36,782.99
			$3,695,065.53

The foregoing property represents the following Funds and Balances, and is answerable for the same.

The income of the following is used for the general purposes of the Institute: —

William Barton Rogers Memorial Fund . . .		250,225.00	
Richard Perkins Fund		50,000.00	
George Bucknam Dorr Fund		49,573.47	
Martha Ann Edwards "		30,000.00	
Nathaniel C. Nash "		10,000.00	
Sidney Bartlett "		10,000.00	
Robert E. Rogers "		7,680.77	
Albion K. P. Welch "		5,000.00	
Stanton Blake "		5,000.00	
McGregor "		2,500.00	
Katharine B. Lowell "		5,000.00	
Samuel E. Sawyer "		4,764.40	
John W. and Belinda Randall Fund		83,452.36	
James Fund		163,654.21	
George Robert Armstrong Fund		5,000.00	
Arthur T. Lyman Fund		5,000.00	686,850.21
Amount carried up			$686,850.21

Amount brought up		$686,850.21
The income of the following is used towards paying salaries:—		
Nathaniel Thayer, for Professorship of Physics .	25,000.00	
Jas. Hayward, for Professorship of Engineering,	18,800.00	
William P. Mason, " " Geology . .	18,800.00	
Henry B. Rogers, for general salaries	25,000.00	
George A. Gardner, " "	20,000.00	
Sarah H. Forbes, "	500.00	108,100.00
SCHOLARSHIP TRUSTS.		
Richard Perkins Fund	53,330.39	
James Savage "	14,475.51	
Susan H. Swett "	10,332.95	
William Barton Rogers Fund	10,737.98	
Joy Fund	10,271.31	
Elisha Thatcher Loring Fund	5,385.34	
Charles Lewis Flint "	5,297.05	
Thomas Sherwin "	5,000.00	
Farnsworth "	5,000.00	
James H. Mirrlees "	2,855.09	
William F. Huntington "	5,243.70	
T. Sterry Hunt "	3,237.84	
Elisha Atkins "	5,000.00	
Nichols "	5,000.00	
Ann White Vose "	60,841.65	
Ann White Dickinson "	40,695.39	
Dalton Grad. Chemical "	6,239.51	
Willard B. Perkins "	6,653.15	
Billings Student "	50,000.00	
Henry Saltonstall "	10,000.00	
Isaac W. Danforth "	5,200.00	
Charles C. Nichols "	5,000.00	
Richard Lee Russel "	2,000.22	327,797.08
OTHER TRUSTS.		
Charlotte Billings Richardson Ind. Chem. Fund,		37,378.78
Susan Upham Fund		1,303.58
Susan E. Dorr "		16,373.95
William Hall Kerr Library Fund		2,000.00
Charles Lewis Flint " "		5,000.00
Rotch Architectural " "		5,000.00
Rotch Architectural Fund		25,000.00
Rotch Prize "		5,200.00
Rotch "Special" Prize Fund		5,200.00
Edward Austin "		375,399.37
Teachers' "		108,100.00
Saltonstall "		41,416.06
Letter Box "		71.50
MISCELLANEOUS.		
Henry L. Pierce Legacy, 1898	848,000.00	
Joseph B. Glover Legacy	5,000.00	
Arioch Wentworth Legacy, 1904	100,000.00	
Aug. Lowell Lab. Electrical Eng. Fund	68,000.00	
Walker Memorial Fund	15,545.22	
Roentgen-Ray Experiment Fund	981.50	
Sanitary Research Laboratory Fund	3,980.43	
Student Fund	3,569.20	
Physico-Chem. Research Fund	2,995.25	
M. I. T. Stock Account	879,597.34	
Students' Fees received in advance	12,990.00	
Supplies " " "	2,058.45	
Acc'ts Payable	2,157.61	1,944,875.00
		$3,695,065.53

Comparative Statement of Funds, etc.

	Sept. 30, 1903.	Sept. 30, 1904.
Trusts for general purposes	686,850.21	686,850.21
" " Salaries	108,100.00	108,100.00
" " Scholarships	319,275.98	327,797.08
" " Library	7,000.00	7,000.00
Charlotte B. Richardson Ind. Chem. Fund	37,378.78	37,378.78
Susan Upham Fund	1,301.52	1,303.58
Susan E. Dorr "	14,897.01	16,373.95
Rotch Architectural Library Fund	5,000.00	5,000.00
Rotch Architectural Fund	25,000.00	25,000.00
Rotch Prize Fund	5,200.00	5,200.00
Rotch "Special" Prize Fund	5,200.00	5,200.00
Henry L. Pierce Legacy	848,000.00	848,000.00
Saltonstall Fund	41,006.00	41,416.06
Aug. Lowell Lab. Electrical Eng. Fund	68,000.00	68,000.00
Arioch Wentworth Legacy		100,000.00
Edward Austin Fund	371,124.37	375,399.37
Teachers' Fund	107,500.00	108,100.00
Letter Box Fund	54.00	71.50
Students' Deposits	250.00	
Roentgen-Ray Experiment Fund	1,000.00	981.50
Sanitary Research Laboratory Fund	4,507.40	3,980.43
Walker Memorial Fund	703.37	15,545.22
Joseph B. Glover Legacy	5,000.00	5,000.00
Dormitory Fund	4,332.70	3,569.20
Physico-Chem. Research Fund	4,891.00	2,995.25
Notes Payable	25,000.00	
Students' Fees paid in Advance		12,990.00
Supplies " " "		2,058.45
Accounts Payable		2,157.61
M. I. T. Stock Account	930,478.50	879,597.34
	$3,627,050.84	$3,695,065.53
Increase,		
Consisting of:		
Bequests for Special Purposes, etc. (See page 4),	15,302.66	
Gifts and Bequests for General Purposes. (See page 4)	100,000.00	
Net Gain on Bonds sold	4,524.50	
Walker Memorial Fund	14,841.85	
Fees, etc., paid in advance	15,048.45	
Acct's Payable	2,157.61	
Less Expenses more than Income	55,405.66	151,875.07
" Students' Deposits	250.00	
" Sanitary Rese'rch Lab. Fund, expended, net,	526.97	
" Roentgen-Ray Fund, expended	18.50	
" Physico-Chem. Res'rch Fund, expended, net,	1,895.75	
" Dormitory Fund, expended	763.50	
" Notes Payable paid	25,000.00	83,860.38
		$68,014.69

INCOME FROM GENERAL INVESTMENTS, AND APPLICATION THEREOF.

Applied to Salaries	4,324.00	From Dividends, Bank Stocks	90.00
" " Scholarships	11,175.00	" Bonds	63,863.66
" " " James Savage Fund	400.00	" Dividends, Railroad Stocks	1,855.00
" " Charlotte B. Richardson Fund	1,495.15	" " Manufacturing Stocks	796.00
" " Teachers' Fund	4,000.00	" Real Estate Stocks	2,915.00
" " Edward Austin Fund	14,400.00		
" " Rotch Prize Funds	400.00		
" " Rotch Architectural Fund	1,000.00		
" " Library	480.00		
" " General Purposes	26,235.12		
" " Samuel Dorr Annuity	1,000.00		
" " Increase of Funds	872.89		
" " Advances to Bond Premiums	3,737.50		
	$69,519.66		$69,519.66

INCOME FROM WILLIAM BARTON ROGERS MEMORIAL FUND, AND APPLICATION THEREOF.

Paid Massachusetts Institute of Technology	10,610.11	Received Income from Railroad Bonds	11,398.11
Credited to Advances Bond Premiums	788.00		
	$11,398.11		$11,398.11

DETAILS OF SOME ITEMS IN TREASURER'S CASH ACCOUNT.

Rents.

Huntington Hall, for Lowell Lectures	3,500.00	
Land and Building, Clarendon St., on account	4,000.00	
Use of Rooms and Gymnasium	2,667.17	
Cambridge Real Estate	181.64	$10,348.81

Department Supplies.

Applied Mechanics	1,998.27	
Architecture	1,885.52	
Biology	1,714.90	
Brookline Athletic Field	1,245.00	
Chemistry	14,393.67	
Civil Engineering	2,184.64	
Drawing	918.34	
Economics	348.70	
Electrical Engineering	4,322.84	
English	284.14	
Equipment Electro-Chemistry	4,196.93	
Equipment Phys. Chem. Lab.	5,980.78	
General Library	1,799.39	
Geology	1,573.61	
History	791.76	
Mathematics	237.82	
Mechanic Arts	5,578.56	
Mechanical Engineering	2,825.24	
Military	135.87	
Mining	3,795.87	
Modern Languages	93.09	
Naval Architecture	1,437.41	
Physical Culture	142.74	
Physics	5,386.95	
Special Dynamo Plant	2,997.90	$66,269.94

Salaries.

Instruction	261,458.83	
Administration	37,587.98	
Labor	41,602.62	$340,649.43

General Expense.

Window Shades		53.33	
Furniture		2,709.55	
Stationery and Office Supplies		1,479.77	
Postage		2,456.78	
Electrical Wiring, Lamps, etc.		1,816.99	
Sundries		1,354.75	
Express		408.73	
Janitor's Supplies		1,103.10	
Examinations		357.30	
Diplomas and Commissions		491.00	
Washing		735.88	
Telephone Service, Installing Stations, Rentals, Repairs, etc.		1,330.68	
Engine Room Supplies:			
Oil	331.39		
Waste	209.17		
Sundries	39.69	580.25	
Ice		460.68	
Examination Books		420.61	
Graduation Exercises		243.96	
Removing Ashes		161.50	
Glass		136.25	
Union Safe Deposit Vaults (one year)		75.00	
Tech. Reunion		587.55	
Medical Services		53.00	
Plans		805.79	$17,822.45

Repairs.

Department Improvements:		
Architecture	62.60	
Biology	393.90	
Chemistry	730.37	
Civil Engineering	36.86	
Drawing	420.58	
Electrical Engineering	358.19	
Geology	367.26	
Mechanic Arts	627.06	
Mechanical Engineering	187.54	
Mining	258.09	
Naval Architecture	436.55	
Physics	213.36	4,092.36
Rogers Building		1,198.51
Walker "		1,649.46
Engineering Buildings, A and B		921.41
Pierce Building		282.72
Engineering Building, C		285.64
Lowell Building		219.32
Gymnasium Building		141.00
Mechanical Laboratories		516.00
Boiler and Power House		208.66
Tech. Union		17.09
Lunch Room		37.79
Sundries		2.341.11
		$11,911.07

BOSTON, December 2, 1904.

Mr. E. L. Parker, an accountant employed by this committee, has examined the accounts of the Treasurer of the MASSACHUSETTS INSTITUTE OF TECHNOLOGY for the year ending September 30, 1904, and his report is hereto annexed.

We have verified the list of personal property held by the Institute.

CHARLES C. JACKSON,
JAMES P. TOLMAN, } *Members of the Auditing Committee.*

BOSTON, December 2, 1904.

To the Auditing Committee of the
Massachusetts Institute of Technology:

GENTLEMEN,— I have audited the accounts of Mr. George Wigglesworth, Treasurer, for the year ending September 30, 1904.

They are correct, payments duly vouched, and the receipts from students' fees and all other income duly accounted for. The cash at office and in banks, according to the deposit books, is correct. The account of property held by the Institute and the funds and balances, as shown in the Treasurer's report of September 30, 1904, is in accordance with the books.

Respectfully submitted,

EDWARD L. PARKER,
Public Accountant.

Volume 41. Number 2

BULLETIN

OF THE

Massachusetts Institute of Technology

BOSTON

REPORT

OF THE

PRESIDENT AND TREASURER

PRESENTED AT THE DECEMBER MEETING OF THE CORPORATION

JANUARY, 1906

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REPORT OF THE TREASURER.

Members of the Corporation.

President.

HENRY S. PRITCHETT.

Secretary.

FRANCIS H. WILLIAMS.

Treasurer.

GEORGE WIGGLESWORTH.

WILLIAM ENDICOTT.	THOMAS L. LIVERMORE.
HOWARD A. CARSON.	A. LAWRENCE ROTCH.
CHARLES J. PAINE.	JOHN R. FREEMAN.
CHARLES FAIRCHILD.	GEORGE A. GARDNER.
DAVID R. WHITNEY.	WILLIAM H. LINCOLN.
ALEXANDER S. WHEELER.	J. B. SEWALL.
JAMES P. TOLMAN.	CHARLES L. LOVERING.
HOWARD STOCKTON.	A. LAWRENCE LOWELL.
NATHANIEL THAYER.	JAMES P. MUNROE.
CHARLES F. CHOATE.	WILLIAM L. PUTNAM.
HIRAM F. MILLS.	CHARLES G. WELD.
PERCIVAL LOWELL.	EBEN S. DRAPER.
CHARLES MERRIAM.	ROBERT S. PEABODY.
THORNTON K. LOTHROP.	ELIHU THOMSON.
CHARLES C. JACKSON.	ELLIOT C. LEE.
SAMUEL M. FELTON.	JAMES P. STEARNS.
DESMOND FITZGERALD.	LUCIUS TUTTLE.
SAMUEL CABOT.	FREDERICK P. FISH.
FRANCIS BLAKE.	FRANCIS L. HIGGINSON.
CHARLES W. HUBBARD.	CHARLES A. STONE.

W. MURRAY CRANE.

On the Part of the Commonwealth.

HIS EXCELLENCY, WILLIAM L. DOUGLAS, *Governor.*
HON. MARCUS P. KNOWLTON, *Chief Justice of the Supreme Court.*
HON. GEORGE H. MARTIN, *Secretary of the Board of Education.*

Committees of the Corporation.

Executive Committee.

HENRY S. PRITCHETT. } *Ex Officiis.*
GEORGE WIGGLESWORTH. }

A. LAWRENCE LOWELL. HOWARD STOCKTON.
FREDERICK P. FISH. FRANCIS H. WILLIAMS.
THOMAS L. LIVERMORE.

Finance Committee.

WILLIAM ENDICOTT. NATHANIEL THAYER.
DAVID R. WHITNEY. CHARLES F. CHOATE.
CHARLES C. JACKSON. JAMES P. STEARNS.

Committee on the Society of Arts.

HOWARD A. CARSON. GEORGE A. GARDNER.
HIRAM F. MILLS.

Auditing Committee.

CHARLES C. JACKSON. JAMES P. TOLMAN.
WILLIAM L. PUTNAM.

Committee on Nominations.

THORNTON K. LOTHROP. GEORGE A. GARDNER.
DAVID R. WHITNEY. HOWARD A. CARSON.
FRANCIS H. WILLIAMS.

Trustees of the Museum of Fine Arts.

HENRY S. PRITCHETT. A. LAWRENCE ROTCH.
FRANCIS BLAKE.

VISITING COMMITTEES.

Department of Civil Engineering.

HOWARD A. CARSON. DESMOND FITZGERALD.
CHARLES F. CHOATE. JOHN R. FREEMAN.
LUCIUS TUTTLE.

Departments of Mechanical Engineering and Applied Mechanics.

HIRAM F. MILLS. JAMES P. TOLMAN.
FRANCIS BLAKE EBEN S. DRAPER.
ELLIOT C. LEE.

Departments of Mining and Geology.

THOMAS L. LIVERMORE. JAMES P. TOLMAN.
CHARLES FAIRCHILD. CHARLES L. LOVERING.
JAMES P. STEARNS.

Department of Architecture.

ROBERT S. PEABODY. ALEXANDER S. WHEELER.
A. LAWRENCE ROTCH. FRANCIS L. HIGGINSON.
JOHN R. FREEMAN.

Department of Physics.

A. LAWRENCE ROTCH. CHARLES W. HUBBARD.
FRANCIS BLAKE. ELIHU THOMSON.

Department of Electrical Engineering.

ELIHU THOMSON. FREDERICK P. FISH.
FRANCIS BLAKE. CHARLES A. STONE.
PERCIVAL LOWELL.

Departments of Literature, History, and Political Economy.

GEORGE H. MARTIN. JAMES P. MUNROE.
A. LAWRENCE LOWELL. J. B. SEWALL.
CHARLES L. LOVERING.

Departments of Modern Languages and English.

JAMES P. MUNROE. SAMUEL CABOT.
CHARLES C. JACKSON. J. B. SEWALL.

Department of Mathematics.

PERCIVAL LOWELL. WILLIAM L. PUTNAM.
HOWARD STOCKTON. CHARLES F. CHOATE.

Departments of Chemistry and Chemical Engineering.

SAMUEL CABOT. ELLIOT C. LEE.
HIRAM F. MILLS. CHARLES W. HUBBARD.
ELIHU THOMSON. W. MURRAY CRANE.

Department of Biology.

JOHN R. FREEMAN. GEORGE H. MARTIN.
FRANCIS BLAKE. FRANCIS H. WILLIAMS.

Department of Naval Architecture.

CHARLES G. WELD. HOWARD STOCKTON.
CHARLES J. PAINE. WILLIAM H. LINCOLN.

Report of the President.

To the Members of the Corporation:

The Report which I have the honor to present at this time is the sixth annual Report which I have addressed to you, and marks the end of five years of service with the Institute.

The year which has passed has been one of quiet work in the various Departments, but has been marked also by several incidents of more than ordinary interest in the life of the Institute.

The celebration last December of the one-hundredth anniversary of the birthday of President Rogers was an occasion long to be remembered in the history of the Institute. The tribute paid to the founder on that day was a very genuine and a very high one, and was an unusual mark not only of the respect but of the affection in which Mr. Rogers' name is held.

During the whole of the past year those connected with the Institute have been subjected to a somewhat unusual experience in the discussion of what has been called the Harvard-Technology alliance. This plan for a single great technical school instead of two in the community of greater Boston involved certain changes which required careful consideration and which were viewed with very different eyes by different members of our constituency. A little later I give as a part of the history of last year's administration a short résumé of this whole matter.

The Executive Committee of the Institute, also, had upon their hands during the past year a somewhat trying matter in the conduct of the questions arising out of the collision between the police and the students at the time of the November elections. The position which the Institute authorities took in this

matter was that students have no rights other than those pertaining to all other citizens. As a matter of fact, great care was taken to make it clear that, in the opinion of the authorities of the Institute, students must hold themselves obedient to law. But it was equally evident that the police officers should be obedient to the same law and that in the affair between them and the students they had clearly overstepped its limits. The decision which was finally reached by the Police Board, in the degradation of the police officers who were responsible, was a complete vindication of the attitude which the Executive Committee took in the affair.

THE GYMNASIUM BUILDING.

No new buildings have been erected during the past year, with the exception of the new Gymnasium building on the Garrison Street land adjoining the Mechanical Laboratories. This new building was made necessary by the fact that the Boston and Albany Railroad Company felt compelled to use for their own purposes the land covered by the old gymnasium. The new building was built with the aim of securing the best possible building at the lowest cost. The building is considered to be remarkably well suited for its purposes, and it has been secured at a cost of some $2,000. less than the lowest contract price at which it could have been let.

CHANGES IN CORPORATION AND FACULTY.

During the last year there have been no changes in the Corporation and those in the Faculty have not been numerous. We have lost by resignation Professor C. M. Spofford, who resigned his position to go to the Brooklyn Polytechnic Institute as Professor of Civil Engineering. His work here will be taken largely by Professor McKibben and Mr. Thorndike.

Into the Faculty at the beginning of the present year have come a number of new members, including Associate Professor William E. Mott and Assistant Professors Samuel P.

Mulliken, George B. Haven, Walter S. Leland, William J. Drisko, Harrison W. Smith, C.-E. A. Winslow, Carroll W. Doten, and Douglas W. Johnson.

Professor Mott, a graduate of the Institute, comes to us after a very successful service at Cornell University.

STUDENT REGISTRATION.

The student registration of this year as compared with that of last year shows a diminution of approximately one hundred names; that for last year being fifteen hundred and sixty-one, that for the present year fourteen hundred and sixty-six,—a loss of ninety-five names. This loss is partly explained by the large number of rejections at examinations in the present year, namely one hundred and eighteen, compared with sixty-seven rejected last year.

Notwithstanding this difference in rejections, the present registration does indicate a diminution in attendance as compared with that of last year. It is interesting to note that this diminution comes entirely from near-by states, namely from the states of Massachusetts and New York, for New York next to Massachusetts has always been the chief source of students for the Institute of Technology. A comparison of the last two years is as follows:

	1904.	1905.
Massachusetts	889	807
New York	94	71
	983	878

In other words, the diminution this year has come entirely from what might be called local students. The actual number of men coming from outside of Massachusetts and New York is greater than ever before, and the percentage of Massachusetts students to the whole number is the lowest in the history of the Institute, amounting this year to only fifty-five per cent.

That this loss is wholly a local one may be still further indicated by a comparison of the attendance from the three coun-

ties of Massachusetts which furnish the largest number of students.

	1904.	1905.
Middlesex	274	257
Suffolk	255	227
Essex	126	104
	655	598

On the other hand, there has been a gain instead of a loss from nearly all other states, including those in the West, like California, Michigan, Illinois, Missouri, and Minnesota, in which the State Universities are making the most rapid gains.

These losses and gains are to be explained, to my mind, on the following ground: local students are those who feel the most acutely a raise in the tuition fee or in the expense of student life, and this diminution in attendance may be referred to their efforts to secure cheaper tuition. The reduction in attendance of students from New York is doubtless due in similar manner to the attractions of Cornell University, where very great facilities are being offered engineering students at a less cost than in Boston. On the other hand, an increase in tuition does not affect students from abroad in the same way, because such students, as a rule, must have fair resources in order to attend a distant institution at all. During the present year large gains in engineering students have been shown at Cornell and Pennsylvania, both institutions being convenient to men coming from the South and the West, and the latter institution has recently provided new engineering buildings and laboratories of the most attractive sort at a cost of $900,000., and these are exclusive of physical and chemical laboratories. The attendance of graduate and foreign students at the Institute in the present year shows a very satisfactory increase. The number of graduate students has increased from one hundred and eighty-one, last year, to two hundred this year; twenty-eight of these are candidates for advanced degrees.

Students from foreign countries number sixty-six, compared

with fifty-four of last year. These come from twenty-five countries, of which the following send the largest numbers:

China	8
Mexico	7
Ontario	6
England	5
New Brunswick	4
Cuba	4

and three each from Armenia, Australia, Japan, and the Transvaal. From the continent of South America are six students in all.

This casual examination of the attendance for the present year shows a satisfactory representation at the Institute from all sections and is an encouraging exhibition of the appreciation throughout this and other countries of the instruction offered by the Institute.

HARVARD–TECHNOLOGY ALLIANCE.

For a year and a half past the Trustees and friends of the Institute have given serious thought to the discussion of a possible alliance with Harvard University. The question involved many considerations of moment concerning both the present and the future of the Institute whose effects were not easy to foresee. The history of the discussion has been fully given in a special number of the *Technology Review* containing the speeches and arguments both in favor of and against the proposed plan. I add here such details as are necessary to complete this history.

This question was opened by a resolution laid before the Corporation in May, 1904, signed by six members of the Corporation, all of them alumni or former students of the Institute. The resolution provided "that the Executive Committee be requested to ascertain whether any arrangement can be made with Harvard University for a combination of effort in technical education such as will substantially preserve the organization, control, traditions, and the name of the Massachusetts Institute of Technology." The resolution was passed

at the meeting of May 4, 1904, and referred to the Executive Committee of the Corporation. This Executive Committee appointed a sub-committee of its own body consisting of the President and Mr. A. Lawrence Lowell to take up with a similar committee of the Harvard Corporation the consideration of a possible plan. The Committee from the Harvard Corporation consisted of Dr. Henry P. Walcott and Mr. C. F. Adams, 2nd. As the result of their efforts, a tentative plan of alliance was agreed upon which the two committees were ready to recommend to their respective Corporations, and which was as follows (printed now for the first time):

TENTATIVE PLAN OF CO-OPERATION BETWEEN HARVARD UNIVERSITY AND THE MASSACHUSETTS INSTITUTE OF TECHNOLOGY.

Harvard University and the Massachusetts Institute of Technology, without making any change in their organization or general objects, agree to combine their resources to conduct a single school of industrial science, to be known as the Massachusetts Institute of Technology, in the following manner:—

(1) Three members of the Corporation of Harvard University shall be elected members of the Corporation of the Massachusetts Institute of Technology, and also of its Executive Committee, which shall thereafter consist of nine persons.

A member of the Corporation of the Massachusetts Institute of Technology shall be elected a Fellow of Harvard University at the first vacancy which shall occur after this agreement is made.

Vacancies occurring in these seats shall be filled in the same manner.

(2) The initiation of measures for the development and management of the School shall lie with the Executive Committee of the Massachusetts Institute of Technology constituted as provided in Section 1; but all appropriations from funds held by either Corporation and all proposed appointments of officers whose salaries are to be paid therefrom shall be submitted to the Corporation concerned, and approved by them before they are finally adopted. Students' fees in the School shall be fixed, collected, and expended or appropriated by the Corporation of the Institute through its Executive Committee. Except as above provided, the powers of the Corporation and of the Executive Committee of the Massachusetts Institute of Technology, and their relation to the School, shall be as now provided in the Charter and By-laws of the Institute. The President of the Institute shall also have in relation to the School the authority described

by those By-laws, and his salary shall be paid from the funds under the control of the Massachusetts Institute of Technology.

(3) The Massachusetts Institute of Technology shall place at the disposal of the School all funds and property it may now or hereafter possess for the promotion of instruction in industrial science; and, as soon as practicable, shall remove to a location in Boston on the right bank of the Charles River and as nearly as possible opposite to Harvard Square, and shall there erect, furnish and equip buildings having at least the capacity of its present buildings.

(4) Harvard University shall place at the disposal of the School all funds and property it may now or hereafter possess for the promotion of instruction in industrial science, including three-fifths of the income derived from the bequest of the late Gordon McKay.

(5) Within three years after the Institute begins the construction of its buildings—provided that the School is then prepared to give the students of the Lawrence Scientific School all their instruction in industrial science in the new location of the Institute—the Lawrence Scientific School shall be discontinued as a separate school of industrial science, and thereafter Harvard University shall not confer the degrees of S.B. or S.M. in industrial science, or any degrees in engineering subjects, except as provided in Section 6.

(6) The Faculty of the School shall consist of all professors, associate professors and assistant professors in the Massachusetts Institute of Technology and all professors, associate professors and assistant professors in Harvard University who give courses of instruction which lead to degrees in industrial science.

The degrees of S.B. and S.M. in industrial science and all degrees in engineering, the courses of study leading to these degrees and the discipline of the School shall be within the province of the Faculty. Degrees recommended by the Faculty shall be conferred by the two Corporations acting separately.

(7) Students in the Massachusetts Institute of Technology shall have the same privilege as students in Harvard University as regards access to and use of the play-grounds, museums and libraries of the University. Under regulations to be made by the two Corporations they shall be admitted to courses of instruction and to the laboratories of Harvard University, appropriate fees being paid in such cases to the University.

(8) Under regulations to be made by the two Corporations students in Harvard University shall be admitted to the courses of instruction and to the laboratories and libraries of the Institute of Technology, appropriate fees being paid in such cases to the Institute for the benefit of the School.

(9) Separate announcements and a separate catalogue shall be issued

by the Massachusetts Institute of Technology, but in all such publications it shall appear that the Institute is conducted in connection with Harvard University.

(10) This agreement is intended to be perpetual and shall be modified only by the consent of both parties thereto.

(11) The time when this agreement is to go into effect is to be inserted when it can be definitely agreed upon.

The departments of architecture are not included in this agreement and their mutual relations are to be the subject of future discussion and arrangement.

NOVEMBER 14, 1904.

After this proposed plan had been placed before the Corporations of Harvard University and of the Institute, a vote was passed that it should be first submitted to legal advice to determine whether the plan as proposed was in due legal form and whether its provisions contravened in any way the present duties and obligations of either institution. After a careful legal scrutiny, the essential features of the plan were embodied in the following Form of Agreement, which was then submitted to the Corporation of the Institute for its approval.

AGREEMENT BETWEEN HARVARD UNIVERSITY AND THE MASSACHUSETTS INSTITUTE OF TECHNOLOGY FOR CO-OPERATION AND ALLIANCE IN THE CONDUCT AND PROMOTION OF EDUCATION IN INDUSTRIAL SCIENCE.

Harvard University and the Massachusetts Institute of Technology, being convinced, after a careful consideration of the conditions which affect the work of education in industrial science, that such work can be greatly advanced and enlarged by a co-operation of the two institutions, in order to secure mutual assistance, render possible a larger enterprise, promote economy, avoid duplication and competition, and give to the purpose of donors who have bestowed money in trust for that object a fuller accomplishment, do make this agreement, which shall endure so long as it shall be found to serve, to the satisfaction of both institutions, the objects above declared. But, whereas the carrying out of such agreement will require the employment of the income of the funds which the University holds, or will hereafter hold in trust, and the University feels that faithfulness in the performance of these trusts which it has accepted is its first duty, to which all other considerations must yield, this agreement shall not go

into effect until and unless the University shall have applied to the Supreme Judicial Court for instructions and the court shall have made a decree that this agreement may be carried out without violation of its duties as a trustee and in accordance with law and equity.

I

The organization of the University, the organization of the Institute, and the title of each to its property and funds shall remain unaffected by this agreement, as shall also the rights and duties of each in investing and managing its funds.

II

The institution for the combined work of promoting and furnishing education in industrial science, which it is the object of this agreement to establish, shall retain the name of the Massachusetts Institute of Technology; it shall be under the direction of an Executive Committee, and the instruction therein shall be given by a Faculty, which two bodies shall be constituted as herein below provided.

III

The said Executive Committee shall consist of nine persons to be designated by the Massachusetts Institute of Technology, of whom two shall be the President of the corporation of the Institute and the Treasurer of the Institute, and three shall be members of the corporation of the University.

Subject to the restrictions herein below expressed, the said Executive Committee shall have the general administration and superintendence of all matters concerning said combined work, including the appointment of officers of instruction and government, and of servants, the power to remove any of them, the fixing of their salaries, and the prescribing of their duties, the care of buildings, property and equipment, the appropriation of money put at its disposal under this agreement, the fixing, collecting and expending of students' fees, and the supervision and direction of the work of the Faculty, these being substantially the powers now conferred on the Executive Committee of the Institute by its by-laws; it being, however, expressly provided that all appropriations from money furnished either by the University or by the Institute, and all proposed appointments or removals of officers whose salaries are to be paid therefrom, shall be submitted to the corporation concerned and approved by it before being finally adopted, it being understood that student's fees shall be deemed to be furnished by the Institute, and that no change shall be made in those fees without its approval.

The said Executive Committee shall keep records of its proceedings,

and shall make reports to the corporation of the University and the corporation of the Institute annually, and at such other times as either corporation may request.

IV

The President of the Institute for the time being shall be the President of the said Executive Committee, and shall preside at its meetings, when present. His salary, as fixed by the corporation of the Institute, shall be paid from the funds furnished by the Institute. He shall be the Chairman of the Faculty, shall have the superintendence of the several departments, and shall act as general executive and administrative officer subject to the direction and control of said Executive Committee. He shall annually make a report to the corporation of the University and to the corporation of the Institute. Whenever a person shall vacate the office of President of the Institute, he shall thereupon cease to be a member of the said Executive Committee.

V

The Treasurer of the Massachusetts Institute of Technology shall be *ex officio* the Treasurer of the said Executive Committee. He shall, as Treasurer of the said Executive Committee, have charge of the funds put at the disposal of said committee, shall make such payments as the committee may authorize, shall keep accurate accounts of all money received and expended, and shall make report of his doings annually, or oftener if required, to the said committee, and to the corporation of the University and to the corporation of the Institute.

VI

The Faculty shall consist of all the present professors, associate professors, and assistant professors of the Institute, and all professors, associate professors, and assistant professors of the University who now give courses of instruction leading to degrees in industrial science, and such officers hereafter appointed as said Executive Committee may designate. The present professors, associate professors, and assistant professors of the University as aforesaid shall not be removed nor have their present salaries reduced without the consent of the corporation of the University.

Subject to the supervision and direction of the said Executive Committee, the Faculty shall have charge of instruction and discipline.

VII

Subject to the reservations hereinafter set forth, the University shall place at the disposal of said Executive Committee, as above provided, the

net income of all funds which are now credited on its books to the credit of the Lawrence Scientific School, also the use of all machinery, instruments, and equipment which the University holds, and the income of all property which it may hereafter acquire for the promotion of instruction in industrial science, and also three-fifths, but no more, of the net income which may accrue from the bequest and devise of the late Gordon McKay.

VIII

Subject to the reservations herein set forth, the Institute shall place at the disposal of the said Executive Committee the net income of all funds and the use of all property and equipment which the Institute may hold for the promotion of instruction in industrial science, reserving only such amounts and property as it may require to maintain its organization and to carry on such functions as may remain to it independently of the promotion of industrial science.

IX

In so far as money contributed by either corporation under this agreement may be used by the said Executive Committee for the purchase of equipment or supplies, the title thereto shall be in the corporation whose money is appropriated therefor.

X

The site of the institution shall be in Boston on the right bank of the Charles River, as nearly as practicable opposite to Harvard Square, and the Massachusetts Institute of Technology shall there erect, furnish, and equip buildings having the capacity of at least its present buildings. But the Institute shall not be required to proceed with such purchase and construction until it shall have sold a sufficient part of the land which it now owns. Provided, however, that this agreement shall be avoided, if at the end of four years from the time when this agreement goes into effect the Institute shall not have purchased said land and proceeded to a substantial extent with such construction.

XI

Within three years after the Massachusetts Institute of Technology begins the construction of such new buildings, if the Institute is then prepared to give in its new location to the students of the Lawrence Scientific School all needed instruction in industrial science, the Lawrence Scientific School shall be discontinued as a separate school of industrial science so long as this agreement remains in force.

XII

The degrees of Bachelor, Master and Doctor in Science, so far as given in industrial science, and all degrees in engineering, together with the requirements of courses of study leading to these degrees, shall be within the province of the Faculty, and these degrees shall be conferred by the corporations of the University and the Institute, acting separately.

XIII

Male students in the Institute shall have the same privileges as students in Harvard University in the use of the playgrounds, museums, and libraries of the University.

Under regulations to be made by the two corporations, and on payment of proper fees, students of the Institute shall be admitted to courses of instruction and the use of laboratories of the University, outside of those pertaining to industrial science, and students of the University to the courses and use of laboratories of the Institute.

XIV

The corporation and overseers of the University and the corporation of the Massachusetts Institute of Technology shall each have full right at all times to inspect the institution, and suggest to the said Executive Committee changes in the methods of management.

XV

The Department of Architecture in the University and in the Institute respectively are not included in this agreement, but remain unaffected hereby.

XVI

It is expressly provided that, as regards the funds and property of the University and of the Institute respectively, this agreement shall be subject to any special terms and requirements upon which such funds and property may be held; and any property or funds which may be held at any time by either corporation under such terms and restrictions as would prevent the use of them in the precise manner contemplated by this agreement shall, nevertheless, be used by the two corporations respectively for the support, benefit, or encouragement of the scheme agreed upon, in such manner as may be permissible and in accordance with the trusts upon which they may be held.

XVII

The arrangements established by this agreement may be terminated at any time either by the President and Fellows of Harvard University or by the corporation of the Massachusetts Institute of Technology, upon reasonable notice to the other corporation.

In the event of the termination of this agreement, the Massachusetts Institute of Technology must pay, at such prices and upon such terms as the parties may agree upon, and, if they cannot agree thereon, as may be fixed by arbitration (usual arbitration clause), for any buildings or fixtures upon said site, paid for with funds furnished by the University.

XVIII

This agreement shall take effect when finally adopted and approved by the corporation and the overseers of the University and the corporation of the Institute, and when and if a decree of the Supreme Judicial Court, as provided for in the preamble hereof, shall have been obtained.

This plan, before being acted upon, was referred to the Faculty of the Institute for a report and immediately afterwards was submitted to the alumni of the Institute for an expression of opinion. The Faculty by a very large majority, fifty-six to seven, reported against the plan. Both the majority and the minority reports are printed in full in the special number of the *Technology Review* devoted to this matter.

Besides being sent out to many who were not graduates, the plan was submitted to thirty-two hundred graduates. Of this number eighteen hundred and fifty-eight voted, of whom thirteen hundred and seventy-four voted against, and four hundred and sixty-two voted in favor of the proposition. Twenty-two votes proved impossible of classification.

After these reports had all been received, the consideration of the plan was taken up by the Corporation and at a special meeting held on June 9th, 1905, by a vote of twenty-three to fifteen, a resolution was adopted instructing the Committee to present the plan to the Corporation of Harvard University with the approval of the Institute Corporation, provided a favorable decision be had in the matter of the Boylston Street land.

A decision was handed down by the Supreme Court on the sixth day of September, which denied to the Institute any right of this property in fee simple, and specifically enjoined it from either selling or building over the two-thirds area not now occupied. This decision made the carrying out of the agreement entirely impossible for many years to come unless there should be provided promptly a sum of money approximately equal in amount to the value of the land on Boylston Street. As the probability of raising this sum seemed indefinite, and as it was undesirable to leave the matter in a state of uncertainty, the Corporation of the Institute at its meeting on October 11, 1905, instructed the Executive Committee to indicate to the Corporation of Harvard University the fact that this body finds itself unable to go on with the plan. The correspondence which closed this matter is given below:

PRESIDENT CHARLES W. ELIOT,
HARVARD UNIVERSITY, CAMBRIDGE, MASS.

My dear President Eliot:—

I am directed by the Corporation of the Institute of Technology to communicate to you the fact that, in view of the recent decision of the Supreme Court of the State in the case of John Wilson *et al.* vs. The Massachusetts Institute of Technology, the Corporation of the Institute finds it impossible to proceed with the plan of co-operation which was considered at its meeting of June 9.

In communicating this fact the Corporation desires at the same time to express its appreciation of the fairness and courtesy of the Corporation of Harvard University in our common effort to solve a difficult question.

I am,

Very sincerely yours,

HENRY S. PRITCHETT,
President.

OCTOBER 11, 1905.

At a meeting of the President and Fellows of Harvard College in Boston, October 30th, 1905, the following vote was passed:—

Voted, That the committee of conference appointed by this Board May 16, 1904, at the instance of the Corporation of the Massachusetts Institute of Technology be hereby discharged; and that the President be requested

to express to the members of the two committees of conference the high appreciation by the President and Fellows of the foresight, good judgment, and public spirit of which the committees' project for a close affiliation between the Institute and the University gives evidence, and the regret of the President and Fellows that the project has been brought to naught by the recent decision of the Supreme Court, which makes it impossible for the Institute to place itself beside the University.

Voted, To acknowledge hereby the receipt of notice from the Corporation of the Massachusetts Institute of Technology that the negotiation with this Board started by the Institute May 4, 1904, is at an end.

A true copy of record.

Attest:

JEROME D. GREENE,
Secretary to the President.

THE INSTITUTE'S DEVELOPMENT IN THE IMMEDIATE FUTURE.

I have called attention in my two last annual Reports to the desirability of outlining as definitely as possible the future policy of the Institute in respect to a location and to its intellectual and educational aims. The proposed plan of alliance with Harvard University was such an effort; it was definite and was framed to meet a policy which contemplated one great school of technology rather than two. That plan having been dismissed, it remains to turn heartily and earnestly to the development of the Institute in its present site, for it seems to me clear that the decision of the Supreme Court, which made the alliance impossible, has also settled the question of site for at least a number of years to come. We must, as it seems to me, continue to use the land on Boylston Street, and therefore for certainly twenty or twenty-five years the Institute must continue where it has been in the past.

The policy of the Institute, therefore, for the next quarter century seems to me to be stated somewhat definitely in the following way:—

(1) To acquire additional land in the immediate vicinity of the present Engineering Buildings, sufficient to provide for the normal development of the next quarter century.

(2) To provide money for endowment and for building so as to make this site the seat of an effective and well-equipped group of engineering buildings.

(3) To develop on our Brookline site, adjoining the Athletic Field, dormitories for such students as may desire to avail themselves of a community life; these dormitories being constructed on the plan of furnishing simple and inexpensive rooms for men of small means, as well as more ambitious rooms for those who care to pay for them, for the purpose of bringing men together on a democratic plan.

(4) To develop with sound judgment and true perspective in education the intellectual work of the Institute. And while this is put last, it is, of course, first in importance and significance in any institution. The quickening of the means of instruction, the constant examination of the courses to the end that they may serve best the student's needs, a frequent overhauling of requirements so as to preserve a fair perspective of student work,—these are the most important matters of policy which an institution has to settle, and these, of course, lie in the hands of the Faculty.

It is some such programme as this to which it seems to me the Institute of Technology should now commit itself heartily and enthusiastically.

EDUCATIONAL IDEALS.

One of the interesting things which has been brought out by the discussion concerning the possible alliance with Harvard is the evidence which this discussion has given of two entirely different ideals as to what the Institute's work ought to be. According to one view, the Institute should remain an undergraduate institution offering to students fixed and rather rigid courses of undergraduate study leading to the professional work of the engineer, the chemist, the architect. This conception has for its ideal the disciplinary rather than the educational side, and aims to teach men to keep a certain step and do a certain work with energy and precision. The second conception has for its ideal an institution which shall preserve,

indeed, the undergraduate work as its great heart and center, but which shall make this the foundation for a great school of professional, graduate and research work.

These two conceptions, while not opposed, are in a certain sense contradictory and it will be necessary in the end for those who have in charge the educational work of the Institute to lend themselves either to one or the other view. For, if the second conception is to hold, there must be introduced into the Institute's courses a somewhat greater elasticity. It must be made easier for men to come to the Institute, and get what they wish, whether adhering absolutely to any prescribed course or not. It must be made easier, also, for men to take up such professional and graduate work whether they come into it from the undergraduate courses of the Institute or through the training of some other institution.

This choice of an educational ideal or general educational policy is before us now in a very practical way, since one-seventh of our students have already had college instruction. Most of these are college graduates. These men are asking and will ask in increasing measure a larger elasticity in their choice of work and greater convenience in fitting themselves to the requirements of our régime. If the Institute is permanently to attract such men, it must make such elasticity, in the higher years of the courses, possible.

It is the second of these views, that one which contemplates not only a graduate school but the work of research as well, which seems to me the true one and the one which promises the greatest results in leadership and power.

EDUCATIONAL DEVELOPMENT IN THE INSTITUTE.

In the reports of the heads of Departments will be found a number of recommendations as to the specific things in which the instruction at the Institute may be bettered or freshened. Thus, in the Department of Electrical Engineering, the head of the Department writes: "The matter of the Course Scheme has been considered by the Department with great care and at

considerable length. The conclusions reached are that a radical simplification is most desirable, in fact, is absolutely necessary, since the students are working under pressure in too many subjects. The time for the digestion and assimilation of what is presented to them and for clear and careful thinking must be very considerably increased. This can be brought about by the elimination of certain work."

In the Course in Chemistry and Chemical Engineering, the head of the Department calls attention to radical and important changes. In the fundamental subjects of Mathematics and of Physics, the heads of Departments refer to changes which they recommend in the courses, or which they hope to recommend.

With regard to the development of educational efficiency, it may be said that an institution of learning necessarily leaves much more to the individual teacher than is left in other organizations. While this gives play in a certain way to individual initiative, it also means that the changes which are made and which involve the consent of many individuals, come very slowly and only after the need for the change has been made very manifest. It has seemed to me for some years that our courses of study might be improved if we could take them up afresh and construct as nearly as possible what might be called ideal courses at the present time, and this not only with respect to the professional engineering Departments but with respect to the more fundamental subjects like Mechanics, Chemistry, and Physics.

It is somewhat singular that Mathematics, the oldest of the sciences, lends itself even in our day less easily as a tool in the applied sciences than Physics or Chemistry. I believe that this is due to the methods pursued in our schools and universities in teaching it,—a method in which the subject is separated into divisions under the heads of Higher Algebra, Analytic Geometry, Differential and Integral Calculus and the like. When one considers that in the Institute of Technology, as in most technical schools, two years only are given to these subjects, and but a small number of hours in each year, it is not

surprising that the student should fail to get a good grasp of such a tool for instance as the Calculus. A wiser plan would seem to be to treat the whole time for the two years as given to a single course in Mathematics; to demand of the student Trigonometry at entrance. Beginning, then, with the first year, the student could be introduced at once to the equation as a means of representing geometric form and could learn to derive the equations of conics as well as of higher plane curves and of other curves which have valuable properties. Having done this, he can be introduced at once to the simple machinery of differentiation and integration from which he can take up at once the analysis of all such curves, deriving the equations of tangents, normals, asymptotes by means of the Calculus and determining also lengths of arcs and values of areas. In the same way he might take up most of the work which is given in Higher Algebra under more cumbersome and clumsy methods, with the result that at the end of the second year he ought to find himself using the Calculus as a tool deftly and easily.

In general, without going into specific recommendations, it seems to me clear that those who are to lead in the technical schools of America need to lend their efforts toward making as great an economy as can be effected in introducing students to the practical applications of Mathematics, Mechanics, Physics, and Chemistry, to the end that these fundamental subjects may serve not only the purpose of general training but the much larger purpose of connecting the student's thinking with the effective application of that thinking,—which is, after all, the direction in which technical education ought to show its greatest efficiency.

ADMINISTRATION AS RELATED TO EDUCATIONAL EFFICIENCY.

The question of what is the best form of administration for an educational institution has received increasing attention in the last two years. In most American institutions the administration has assumed a form much more resembling that of a

business organization than is the custom in foreign universities and technical schools.

Whether this tendency is a good one or not is certainly an open question, for, however desirable it may be to secure a due sense of responsibility on the part of teachers and students, it is also true that the best intellectual results are likely to come with a larger measure of freedom. On the other hand, it is also evident that an administration in which the individuality of the teacher and of the student is conserved offers serious difficulties in the way of what may be called initiative. When a course of study or a change in the plan of organization or other important question within the institution is to be determined by the votes of a large number of men acting on their individual judgment, it is evident that the inertia of the organization must be much greater than if the power is lodged in the hands of one man or in a small body of men. Nearly all administration is a compromise between these two ideals,—the ideal of the executive officer or small committee with large power insuring well-defined responsibility throughout all parts of the organization and also power of initiative, and the other ideal of individual freedom of action based on the consent of all members within the organization and necessarily, therefore, acting slowly and without great initiative.

It seems clear to me that the idea of the individual freedom of the professor is a fundamental condition in any institution of learning. It also seems to me equally clear that this freedom must extend in some measure at least to the student, and that also some means must be had to increase the power of initiative of our educational organizations. Our Institutions of learning are conducted on the intellectual side wholly by the Faculties. These have now become quite large in the larger institutions, and, when we introduce the ideal of the preservation of individual freedom and combine it with the plan of organization which assigns only a single professor to a single subject, we preserve a system which has the faults of both plans of organization. It remains, perhaps, for the American professors

themselves to suggest some means of administration which, while preserving the individual freedom of the professor, may at the same time give to educational organizations somewhat of the initiative which we find in business organizations.

A partial step toward this result would be reached in the Institute if the separate Departments of professional study were considered as schools and the determination of their Courses of Study left more fully to these separate faculties. In fact the name Institute would most fitly indicate a congeries of schools and it ought to be possible to administer the School of Architecture, of Civil Engineering and the like without losing the trust which now exists between Departments having these names, while leaving to each larger initiative.

ATHLETICS.

With the building of a new gymnasium on our land on Garrison Street and with the equipment of our Athletic Field in Brookline, the Institute is now well furnished with facilities for athletic exercise and athletic sport. The new gymnasium is well lighted and heated and is plentifully provided with shower baths, while on the Athletic Grounds in Brookline are provided not only the ordinary facilities for football, and baseball, and track but also tennis courts as well. In fact for the ordinary undergraduate athletic life, the Institute is well equipped, the sole objection to the arrangement as it now stands being the fifteen minutes of time necessary to go from the Institute's site to the athletic grounds.

The athletic life in the Institute of Technology represents, in my judgment, a sane and normal development. There is a very hearty athletic spirit and this shows itself principally in the cross-country runs, in the track team, and in the other events in which the individual can most easily enter.

Five years ago an arrangement was made with the student-body under which intercollege football was given up, with the substitution of the annual Field Day football game between the Freshman and the Sophomore classes. This annual field

event has grown into a most satisfactory and interesting occasion. It concentrates into one effort much of the athletic activity of the two younger classes.

There are men in the Institute to-day who would be the better for a longer time spent in open-air exercise or some athletic sport, but there are very few who have pursued athletics to the injury of their college work.

When one considers in how great measure the athletic development in our colleges and universities has displaced scholarship, the present situation in the Institute of Technology is one in which there is a certain amount of satisfaction. In the Institute to-day athletics remains still a sport and it has become neither an occupation nor a business. In this connection I wish to express again the obligation of the Corporation, of the Faculty, and of the student-body to the Advisory Council on Athletics for the admirable work which that body has done and to add the suggestion that an athletic system carried on as ours is necessarily brings in small receipts, not enough for the modest needs of the régime now established. If the Advisory Council could have the assistance of some $1,000 a year it would enable them to conduct their work without the difficulties now connected with it.

THE FINANCIAL SHOWING FOR THE YEAR.

The Treasurer's Report, which is appended, gives in detail the financial showing for the past year. The exhibit is a very satisfactory one and is particularly gratifying in comparison with last year, for, although there is still a deficit of something over $10,000, this deficit is small compared with the $55,000 of the year before. This change has been effected by an increase of some $23,000 in the income, due to the higher tuition fee, accompanied by a decrease of some $19,000 in the total expenses. This saving has been effected by an effort to economize in many directions, with the general understanding that economy should be effected in material expenses, rather than in the salaries of professors and instructors.

The greatest saving has been effected in the matter of departmental supplies, and with due effort for economy by those connected with the Institute for the coming year it may be hoped that our deficit may be small for the present year.

This showing is due in the main to the admirable work of the Treasurer and of the Bursar.

REPORTS OF DEPARTMENTS.

The needs of the various Departments are set forth in the reports of the heads of Departments, which are printed in connection with this Report. These reports state more clearly than can be given here the views of the department heads. I commend these to the careful consideration of this body.

HENRY S. PRITCHETT.

DECEMBER 13, 1905.

Reports of Departments.

DEPARTMENTS OF CIVIL ENGINEERING AND SANITARY ENGINEERING.

The instructing staff in the Department of Civil Engineering has been materially strengthened during the past year by the addition of Professor W. E. Mott, who comes from Cornell University, as Associate Professor of Hydraulic Engineering, and of Mr. George E. Russell, who also comes from Cornell University, and enters the Institute as Instructor in Civil Engineering.

Professor Mott graduated from the Institute in the Class of 1889, with an enviable record. Since that time he has been engaged in practical engineering work and for a number of years has been connected with the Civil Engineering staff of Cornell University. Professor Mott comes to us after mature experience as a teacher and an engineer and brings new ideas gained at another institution. His accession will be a source of gratification to all who are interested in the Institute. He will devote his time principally to instruction in Hydraulics.

Mr. Russell graduated from the Department of Civil Engineering of the Institute in 1900, and was for a year an Assistant in the same Department. Resigning his position to engage in practical work, he was connected for a number of years with the American Car and Foundry Company, in the work of designing and building steel cars. His experience in this position gave him a good insight into the engineering and business operations of large corporations. A year ago he resigned his position to engage again in teaching as Instructor in Civil

Engineering at Cornell University. His experience and training make him a valuable addition to the staff of the Department.

Mr. S. H. Thorndike, who a year ago was appointed Instructor in Civil Engineering, is to devote his attention hereafter to the work of Stereotomy and Structural Design, his connection with the City Engineer's department having given him valuable experience in both these lines.

The staff of the Department has suffered a loss in the resignation of Professor C. M. Spofford, who, after a service of nine years, has resigned to become Professor of Civil Engineering at the Brooklyn Polytechnic Institute. Professor Spofford will be much missed, and the good wishes of all his associates go with him in his new position. His work will be taken largely by Professor McKibben and Mr. Thorndike.

Mr. J. W. Howard, who has been an Assistant in the Department, has been promoted to be Instructor in Civil Engineering. All the other Assistants who served last year have resigned to engage in practical work. To fill their places, seven of the graduates of the Class of 1905 have been appointed Assistants in Civil Engineering, namely, Messrs. J. Ayer, J. E. Barlow, C. T. Humphrey, J. H. McManus, W. E. Simpson, F. C. Starr, and K. Whitman, Jr.

The course of study in the Department has not been modified, except so far as was necessary to adapt it to the increased entrance requirements, which this year render a change necessary in the third-year work.

The number of students in the second year is about the same as last year. The number in the two upper classes is somewhat greater. It is not desired that the number should increase very greatly; but, with our strengthened staff, we ought to be able to make our instruction more efficient than ever before, and also to provide opportunities for advanced work, should any candidates for such work present themselves.

The equipment of the Department has been added to by the purchase of several new transits and other surveying instru-

ments. Provision has also been made by which a larger number of students can be accommodated in the second-year drawing-room. The Department needs, however, a considerable increase in space in order to provide in the most efficient manner even for our present students. The drawing-rooms are too crowded already, and the only way to provide for an increase in numbers would be to allow two students to occupy the same desk. This is practicable in the second year; but in the third year, when the students are at their desks so much of the time, it would be a serious handicap if each man were not furnished with a desk of his own. We should have also a larger number of lecture-rooms which could be devoted to the work of the Department and in which work could be left on the blackboard from exercise to exercise. We need very much a large lecture-room capable of accommodating not only the entire second-year class, but an even larger number of students.

The Engineering Library is near the limit of its capacity, and offers practically no facilities now for the quiet occupancy of tables by students. It is growing fast in number of volumes and is becoming very valuable; the floor-area devoted to it should be doubled or tripled.

The Summer School in Surveying was held during the last summer at East Machias, Maine. Eight students attended. As this school is now open to students in the second and third years, it will probably be given only every other year.

Altogether the work of the Department is proceeding satisfactorily. The staff is larger than ever before and sufficient for the number of students. The work this year should be better than for some time past. The principal need of the Department is for more space.

The class which graduated last June numbered about sixty-five students. It is gratifying to be able to state that, notwithstanding the size of the class, the applications for our men have been more numerous than ever before, and that we could have found places for two or three times as many men as were available. Altogether, since about the first of last May, there

have been 128 positions offered suitable for young men just graduating. These situations may be classified as follows:—

Railroad work	47
Structural work	16
Hydraulic, Sanitary, and Municipal work	33
Miscellaneous	32

GEORGE F. SWAIN.

DEPARTMENTS OF MECHANICAL ENGINEERING AND APPLIED MECHANICS.

A number of improvements have been made in the Course in Mechanical Engineering in consequence of the additional time gained through the increase in the entrance requirements. These improvements have now become effective in the work of the third-year and of the fourth-year classes.

Besides considerable gain in the time devoted to literary studies, that given to Differential Equations has been trebled, a course has been added in Precision of Measurements, the time devoted to instruction in Electrical Engineering has been doubled, and a considerable increase has been made in that devoted to each of the four Options, viz., Marine Engineering, Locomotive Engineering, Mill Engineering, and Heating and Ventilating Engineering. With these additions, and with the constant development of all the work in the Department, the Course has been materially improved, both from the literary and from the professional standpoints.

In connection with the thesis work, a very considerable amount of investigation has, as usual, been carried on, of which some has developed results of importance in engineering.

Through the kindness of the Westinghouse Air Brake Company, the Department has received, as a gift, a complete and modern brake equipment for an electric car, including the motor.

The number of students to whom instruction is given in Mechanical Engineering subjects is eight hundred and twenty-

two, and the number receiving instruction in Applied Mechanics is four hundred and ninety-five.

The statements made in the Report of last year regarding the urgent need of considerable additional apparatus in order to give the needed laboratory instruction, and to carry on the amount of research work which is customary in this Department will not be repeated here. These needs are, however, fully as great as ever before, and even greater, and the lack of such additional apparatus must result in a decrease of the amount of this kind of instruction for a certain number of students. No special appropriation has been made for new apparatus since the year 1900, and the appropriation made this year for the regular expenses of these Departments is the same as it was in 1892–'93, when the total number of students was much smaller.

A number of members of the instructing staff of these Departments have been called upon for additional work in connection with the administrative work of the Institute, in connection with the work of the Lowell School for Industrial Foremen, and in other connections.

GAETANO LANZA.

DEPARTMENT OF MINING ENGINEERING AND METALLURGY.

The facilities in the Ore-dressing Laboratory have been improved by the addition of a new small-sized Wilfley concentrating table; this will relieve the congestion in demand for the present table. A high power Wetherill magnet is being installed to treat sands of all degrees of magnetic susceptibility, effecting separations that are impossible with the wet machines alone. The steam engine has been set aside for the electric motor, a change which results in a saving in coal and the additional advantage that this motor can be run night and day. A new automatic discharge has been put upon the jig to draw off the concentrates while the jig is at work; this brings one

more method of concentration to the attention of the students. A small low-pressure boiler for heating the steam drying tables in summer has been installed. The use of small electric motors for running little machines is being adopted with great advantage in saving wear and expense. Professor Richards's new pulsator is installed in the laboratory for the use of the students. No changes have been made in the Smelting Laboratory or in that of Metallography. A new balance has been supplied for the Assaying Laboratory.

In the library, while no large addition has been made, the current publications have been carefully scrutinized by Professor Hofman and copies have been added to the list when their value seemed to warrant it. A new book case has been provided, but the library is much too small.

A moderate amount of outside professional work by the teachers benefits both school and pupil by keeping the teacher in touch with the latest developments in his subjects. The problem of concentrating the black sand of the Pacific coast undertaken by the United States Geological Survey at the Lewis and Clark Exposition offered an unusual opportunity for investigation. Professor Richards spent three months at Portland, Oregon, in the employ of the Survey on this work. Part of the work was carried on at the Institute by Messrs. Locke, Brown, Reed, Glidden, Barnaby, and Hayden of the Mining Department, and by Professor Warren of the Department of Geology.

The students in the fourth, third, and second years number forty, thirty, and forty respectively, a fact which shows that the numbers are nearly keeping up to the highest figure. There are more college graduates than ever before.

The John Cummings Laboratory of Mining Engineering and Metallurgy is so full of apparatus that an instalment of a new machine can be made only by removing an old one. In this case the machine having the least value for instruction will be rejected.

The Summer School, in charge of Professor Hofman, aided

by Mr. Locke, studied the smelting and refining of lead, copper, and the precious metals at the works of the American Smelting and Refining Company at Perth Amboy, New Jersey; the refining of copper at the De la Mar Copper Company's works at Chrome, New Jersey; the mining and concentrating of zinc at the mine and works of the New Jersey Zinc Company at Franklin Furnace; zinc and spiegeleisen smelting and a sulphuric acid plant at Hazard, Pennsylvania; the electrolytic refining of gold and silver at the United States Mint in Philadelphia; coking coal, smelting iron, and Bessemer steel at the works of the Maryland Steel Company at Sparrows Point, Maryland; smelting iron, Bessemer steel, and open hearth steel at the Carnegie Steel Company's Braddock and Homestead works, near Pittsburg; the making of black plate and tin plate by the American Sheet and Tin Plate Company; the making of steel pipes by the National Tube Company; the drying of air for the blast furnace by the Gayley Refrigerating Process at the Isabella furnaces; the mining, screening, and shipping of coal at the Hazel Mine of the Pittsburg and Buffalo Coal Company at Canonsburg; the puddling process and the manufacture of high grade crucible steel at the Crescent Works; puddling at the Sable Iron Works; the malleabilizing of castings by the Pittsburg Malleable Iron Company; and the water works of the Pittsburg Filtration Plant.

The Department desires to record here its thanks for the generous and cordial welcome given to the students of the Summer School by the managers of the above mentioned companies and firms.

ROBERT H. RICHARDS.

DEPARTMENT OF ARCHITECTURE.

This year has opened with numbers that have tested the full capacity of our floors. The material changes made last summer in the arrangement and lighting of our drawing-rooms have proved very successful. A floor area which formerly

was poorly lighted has now become most available, and the screens that have been added now permit us to show to the best advantage our very valuable collection of drawings. Yet, with all these good conditions, we are still cramped.

The good results of bringing the advanced classes into closer touch with each other in the drawing-rooms are already being seen, and our larger exhibition room permits of calling the students together at short intervals to discuss their current problems in design, and to receive criticism on their work. All this tends toward the formation of an *esprit de corps*, as well as toward a closer co-operation between student and instructor than we have been able hitherto to bring about. It seems advisable to develop in the highest degree those lines of work which we have already undertaken rather than to start anything new.

The Rotch Prize of two hundred dollars for the regular student making the best record during the four years was given to Miss Ida A. Ryan, and the prize of two hundred to the special student doing the best work during two years was divided equally between Mr. W. H. Crowell and Mr. M. H. Whitehouse.

The Boston Society of Architects also gave two prizes of the value of fifty dollars each in books, one to Miss Ida A. Ryan, and one to Mr. W. P. Delano, Jr. These two prizes were given for skill in design, the decision being made by the Society. The occasion was celebrated by a dinner of the Department, given by the Boston Society of Architects to the fourth-year class. Dr. Pritchett was the guest of honor, and announced the awards.

"The Class of 1904 Competition Prize" was awarded last year for the first time. This prize gives ten dollars each to the regular and the special students whose designs are placed first in a competition held between the Christmas and the mid-year recesses. The first was given to Mr. A. Blodgett, and the second to Mr. P. F. Mann.

Of particular interest to the Department will be the award at the end of the school year of a travelling scholarship amounting

to twelve hundred dollars, the very generous gift of a friend. "It is to be awarded solely on the basis of distinguished merit," but candidates must have passed two consecutive years in the Department, and at least one of the years must have been in the Graduate Course.

A fact worthy of note is that Mr. W. D. Crowell, a student with us two years ago, recently won and is now holding the Rotch Travelling Scholarship of two thousand dollars for two years' study abroad.

It is a satisfaction to note the continuance of a good graduate class, and also the large number of college graduates who have entered this year, many of them candidates for our degree.

FRANCIS C. CHANDLER.

DEPARTMENTS OF CHEMISTRY AND CHEMICAL ENGINEERING.

During the past year radical and important changes have been made in the schedules of the Courses in Chemistry and Chemical Engineering. It became necessary some years ago to make an arrangement by which the students of the Course in Chemistry who were fitting themselves for technical positions should have an opportunity to obtain some instruction along engineering lines, in order that they might be able, as occasion offered, to pass from the chemical laboratory to positions of larger responsibility in the management of industrial plants, where some knowledge of the principles of Mechanics and of Steam Engineering is indispensable. At this time five series of optional studies, continuing through the last three years of the Course, were arranged, among them one involving certain fundamental work in Mathematics, Mechanics, and Steam Engineering, while at the same time the student completed all of the general and some of the special subjects of the Course in Chemistry. The Course in Chemical Engineering, on the other hand, offered a course in which the greater stress was

laid upon the work of the Department of Mechanical Engineering, the smaller portion of the time being devoted to chemical subjects. These two Courses have existed together since 1900. It has, however, become increasingly evident from a consideration of the character of the recent calls for our graduates that the training afforded by the Option of the Course in Chemistry referred to above did not afford sufficient experience in mechanical lines to enable the graduates to take up their work with the best attainable efficiency, and, on the other hand, many of the graduates from the Course in Chemical Engineering deplored their limited experience on the chemical side. It moreover seems evident that the chemical engineer of the future must be a man who has a fundamental knowledge of chemical principles, that is, a man who is primarily a chemist, but combines with this knowledge as much of the fundamental principles of engineering practice as it is possible for him to acquire in the years available for study. He must not only know thoroughly the meaning of the chemical equation, and its underlying principles as written on paper, or carried out in the test-tube, but must also have the ability to take an active share in transferring the reactions of the test-tube to a productive plant upon a technical scale.

The necessity for a rearrangement of the two higher years of all Courses, which has resulted from the changes in the requirements in Modern Languages, made this an opportune moment to attempt a reconstruction of the schedules of both the Courses under discussion. The initial efforts to bring each of them more into line with the conditions outlined above soon made it clear to the members of the Department that the resulting schedules differed so little as to make their separate maintenance inadvisable. This position was ultimately accepted by the Faculty, with the result that the Option of the Course in Chemistry containing the engineering subjects has been discontinued, and the Course in Chemical Engineering has taken on the character of a chemical course, with a fair share of fundamental instruction in Mechanism, Applied Mechanics, Steam Engi-

neering, and the drawing which accompanies these subjects: The specialized courses in Chemistry have been necessarily omitted, and the analytical practice is slightly less than in the Course in Chemistry. The hours devoted to Mechanism, Applied Mechanics and Steam Engineering are also somewhat less than in the Course as it has been offered for a number of years. The remaining hours and subjects afford, however, a fundamental training in each field, and it is believed that they approach as closely as possible in the time available to the requirements of the technical chemist, who, under the existing industrial conditions, must be a chemical engineer. It is, nevertheless, unquestionably true that this composite training demands for its best fulfilment an additional year of study, in which, with the fundamental work as a basis, the student's knowledge of both Chemistry and Engineering can be so developed as to enable him better to grasp the applicability of principles to problems, thus increasing the ready availability of his store of information.

Other significant features of the changes in the course schedule are the transfer of the instruction in Industrial Chemistry to the fourth year, the re-adjustment of the instruction in Organic Chemistry, so that it commences in the third year and is accompanied from the start by laboratory work, and the transfer of all instruction in Theoretical Chemistry to the fourth year, with an increase in laboratory instruction in this subject. Corresponding changes will soon be made in the Course in Chemistry.

The series of optional studies in the Course in Chemistry known as the Metallurgical Option has also been discontinued. This Option was taken by only a few students, and complicated the work of the fourth year of the Course.

The year has been one of general prosperity in the various branches of the Department. While no striking innovations in methods are to be noted, instruction in many of the subjects has been modified in minor details, with, in most instances, favorable results. A new course of instruction in Inorganic Chemistry has been introduced into the Course in Chemistry, and the time

devoted to Industrial Chemistry has been extended for all Courses, both constituting much-desired changes. New advanced elective courses on the "Recent Developments in Organic Chemistry" and the "Chemistry of the Technically Important Organic Compounds" have been offered by Professor Moore, and the promotion of Dr. S. P. Mulliken to be Assistant Professor of Organic Chemical Research is indicative of the intention of the Institute to offer increased opportunity for advanced work in this field.

During the past year new books have been published, as noted in the List of Publications, by Mr. Rolfe, Mrs. Richards, and Drs. Talbot and Blanchard, while Dr. Thorp has completed a new edition of his "Outlines of Industrial Chemistry."

Of the recent graduates from the Department Messrs. A. W. Rowe and R. S. Williams are now students in the Universities at Heidelberg and Göttingen respectively, and Drs. R. S. Balcom and S. C. Lind have recently returned from abroad and have accepted positions as Instructors at the University of Michigan.

The experience of the past year has clearly emphasized the increasing difficulty which technical institutions in particular are likely to meet with in retaining the services of efficient teachers. Three of the members of the instructing staff in Chemistry and one in the Research Laboratory have been called upon to choose between continued devotion to the work of a teacher, or an investigator associated with an institution of learning, and a field of labor in which the work should be essentially technical in its character, but should bring with it distinctly larger financial returns. It is creditable alike to these men and to the Department that they should have been sought out for positions of marked responsibility demanding ability of a high grade, and it is the good fortune of the Institute that Professors Walker and Fay have determined to continue their work with us. It should be pointed out that it is by no means the financial attraction alone which determined a choice

in favor of the industrial positions in the other instances referred to, but rather the attractiveness of the work in the research laboratories which have sprung up in connection with several of our important industries and to which these men have been called. These laboratories, like that under the direction of Professor Whitney at Schenectady, offer opportunities for productive work which are unsurpassed and well worthy of the consideration of men of ability. The awakening interest in the establishment of such laboratories and the significance of chemical control and oversight in many manufacturing operations seems likely to increase rather than to decrease the difficulties involved in commanding the services of able men as teachers in Chemistry, unless these positions can also be made financially attractive and the routine work of teaching and administration reduced to a minimum. The Department still has thoughtful teachers and able men, but more rather than fewer are needed.

The statements made in the Reports of recent years concerning the urgent need for additional facilities, especially for the better accommodation of our teachers and the encouragement of research work among them, and, in particular, for the re-uniting of the scattered branches of the departmental work, certainly apply with equal force at this time. It is our hope that relief may be found in some feature of the plans for the development of the Institute to be considered in the near future.

H. P. TALBOT.

RESEARCH LABORATORY OF PHYSICAL CHEMISTRY.

The Laboratory has suffered a severe loss in the resignation from its staff of Professor W. D. Coolidge, who has accepted an attractive position in the technical research laboratory of the General Electric Company at Schenectady, where he will be closely associated with Professor W. R. Whitney. To Professor Coolidge has been due the development of one of the

most important lines of work in progress in the Research Laboratory of the Institute,—the investigation of the conductivity of aqueous solutions at high temperatures,—a research that will be continued not only by several investigators at the Institute, but also by Professor Coolidge at Schenectady. Mr. Yogoro Kato, who has also been engaged on the conductivity investigation for two years, has accepted a position in the leading technological institute in Japan, the Technical High School of Tokio, where he will have charge of the work in Inorganic Chemistry and Electro-Chemistry. Dr. Wilhelm Böttger returns as Privat-Docent to the University of Leipzig, at which he will conduct one of the laboratory courses in Analytical Chemistry.

In place of these retiring members the following new appointments to the research staff have been made: William C. Bray, B.A., Toronto, '02, Ph.D., Leipzig, '05; Guy W. Eastman, S.B., M.I.T., '04; Gilbert N. Lewis, Ph.D., Harvard; Edward W. Washburn, S.B., M.I.T., '05. Mr. Roy D. Mailey has been promoted to the position of Research Associate.

Professor Wilhelm Ostwald, of the University of Leipsic, is delivering during the present term at the Institute a course of six lectures, on the Historical Development of Chemistry. The whole Instructing Staff of the Institute and all students in the Courses in Chemistry and Physics have been invited to attend. Besides these lectures, two new advanced courses are being given this year in connection with the laboratory through the co-operation of members of other Departments—one by Professor Warren on the Geometrical and Physical Properties of Crystals and one by Dr. Blanchard on Oxidation and Reduction. The laboratory course in Glass Blowing, under the charge of Mr. C. A. Kraus, is being continued.

At the close of the last school year a second gift of two hundred dollars was received from Mr. Samuel Cabot for use in promoting the investigations in the Research Laboratory. The Laboratory has also been assisted by a further grant of five hundred dollars from the William E. Hale Fund.

Seven candidates for the degree of Doctor of Philosophy are now pursuing work in the Laboratory.

The researches described in the Report of last year are all being continued, and one new line of investigation has been entered upon,—that of the hydration of salts in aqueous solutions. This constitutes one of the most important as well as one of the most difficult of the unsolved problems relating to solutions, and is being attacked by two independent methods, both of which give promise of success, by Mr. Edward W. Washburn and Mr. Richard C. Tolman. A series of eight articles describing the researches made in the Laboratory during the last two years is about to be submitted to the Carnegie Institution for publication.

A. A. NOYES.

DEPARTMENT OF ELECTRICAL ENGINEERING.

The significant changes which have been made in the instruction in this Department during the past year, other than those relating to distinct changes of course scheme, concern the introduction of recitations in place of lectures, a change which has given most satisfactory results, and the assignment of problem work for solution in the class-room rather than outside the Institute. This last has produced a distinct gain among the students in the power of rapid and accurate thinking, and seems to the Department a principle well worth broad extension in Institute work. The possibility of replacing lectures by recitations is due in some degree to the preparation of notes by members of the instructing staff of the Department for their classes, and this will, it is hoped, be considerably extended in the near future. It is gratifying to observe that the journal meetings are bringing about a much freer use, not only of current periodicals, but of the department library as well.

The matter of the course scheme has been considered by the Department with great care and at considerable length. The conclusions reached are that a radical simplification is

most desirable, in fact is absolutely necessary, since the students are working under pressure on too many subjects. The time for the digestion and assimilation of what is presented to them and for clear and careful thinking must be very considerably increased. This can be brought about by the elimination of certain work of lesser importance and the devotion of greater time to exercises, both written and oral, under the immediate supervision of the instructing staff.

The reports of students in connection with the excursions to the various power plants in Boston and vicinity have shown a very great gain in clearness of expression and logical arrangement, due in no small degree to the co-operation of the Department of English in this particular line of work. This contact of students with the actual engineering operations going on in their own chosen line of work is something which should certainly be increased, if by any possibility the necessary time can be found for such increase, and the presentation of formal reports in connection therewith should certainly be insisted upon as giving the students the power of analyzing the important features of any engineering process and of giving clear and logical expression to their thoughts.

A change of considerable importance which becomes effective for the first time with the present third-year class is the completion of a large part of the work in the Standardizing Laboratory during the third year, thus giving the fourth year so far as this laboratory is concerned mainly to the study of special problems arising in connection with thesis work. This, together with a considerable increase in the time devoted to Theoretical Electricity, puts the course on a much sounder and more logical basis than that on which it has previously rested.

The facilities of the Standardizing Laboratory have been extended in increasing degree to other Courses, and undoubtedly this laboratory will be depended on by all Departments of the Institute for such work as comes within its special province. There have been very considerable additions to the equipment of the Standardizing Laboratory during the past year, but

notwithstanding these additions there is still a marked deficiency in apparatus essential to the proper carrying on of thesis work.

The equipment of the Dynamo Electric Laboratory, in both apparatus and instruments, still needs very considerable supplementing. The lack of duplicate instruments and apparatus renders it impossible the present year to extend to the students of the Mechanical Engineering Department the training in this laboratory which was suggested by that Department and approved by the Faculty as a desirable change in the curriculum.

The demands on this Department for instruction to students of other Departments are rapidly increasing; and this increase is likely to continue for some years, until a sound training in some of the fundamentals of Electrical Engineering is given to the students in most of the Engineering Departments of the Institute.

These demands, together with the considerable increase in the number of fourth-year students in this Department, render the giving of proper instruction more difficult and make it extremely desirable that there should be in each laboratory, in addition to the Faculty members, at least one person of the grade of Instructor who shall exercise supervision and be immediately responsible to the Professor in charge. This can be realized, I hope, in the immediate future.

The need of more room, which was very plain a year ago, has now become most pressing through the increasing use of the various class-rooms in the Lowell Building for work other than Electrical Engineering and Modern Languages; in fact the departmental instruction in certain directions has been seriously hampered through the inability to secure class-rooms in which experimental illustration can be satisfactorily given. The rooms allotted to research in the original plan of the Augustus Lowell Laboratories have of necessity been taken largely for regular undergraduate work; and in the present year research work carried on by graduate students in the large labora-

tory is seriously hampered by the constant interruptions and disturbances arising from the regular laboratory work.

The demand for graduates of this Department has been particularly keen, the positions offered having largely exceeded in number the available men. Inquiries for men not infrequently specify that only those are desired who can think clearly and concisely and who have a natural adaptability in dealing with men, the knowledge of a great number of details being of secondary importance.

The output of the power plant has shown a steady increase, having risen recently to a value of very nearly six hundred kilowatts. The running of this plant at night, with the consequent shutting off of the Edison service, will undoubtedly result in a certain economy, although since the beginning of night running, on October 30th, the load has shown a steady and marked increase. The facilities of this plant have been extended to the Mechanical Engineering Department for certain laboratory work, and power plant tests have been successfully conducted with great advantage to the students of both Mechanical and Electrical Engineering.

During the past year there have been gifts of certain small pieces of apparatus and various framed photographs from the larger electrical manufacturing companies, and loans of apparatus and instruments for limited periods have also been made by them.

The instruction to students in the Lowell Institute School for Industrial Foremen has been given with most satisfactory results and this year there is being carried on a course of lectures and laboratory work for the Teachers' School of Science. Such instruction as this, giving as it does the services of the staff of the Institute, and the facilities of its laboratories to those engaged in teaching or in the actual conduct of engineering operations, is most important and desirable. So far as it can be carried on without interfering with the regular work of the Institute it should certainly be encouraged.

H. E. CLIFFORD.

DEPARTMENT OF BIOLOGY.

The year has been one of quiet, fruitful work in teaching, and also, as may be seen by an examination of the list of published papers, in research.

The text-book on Physiology and Hygiene upon which Professor Hough (formerly of the Institute and now of Simmons College) and Professor Sedgwick have for some time been engaged is passing through the press of Messrs. Ginn & Co., and will soon be issued. It is entitled "The Human Mechanism: Its Physiology and Hygiene and the Sanitation of Its Surroundings," and should prove a valuable adjunct to that more scientific education in the subjects which it covers which is to-day so greatly needed. In January and February last Professor Sedgwick delivered a course of ten public lectures in the Lowell Institute upon "The Sanitation of Cities", which he hopes before long to find time to publish.

Assistant Professor Prescott has continued his investigations and instruction in Industrial Biology and, as stated below, has opened a private laboratory for the benefit of manufacturers and others desiring investigations and reports upon the efficiency of the bio-chemical processes involved in their work which can not properly be made in an educational institution.

Assistant Professor Winslow's work on Applied Microscopy, a small illustrated volume which appeared in March, was immediately brought into service for our own students and has received favorable recognition elsewhere. In this volume, and in the numerous public addresses which he has given upon sanitary subjects, the author has shown his readiness and his ability to serve the state as well as the Institute.

A sudden, unexpected and unexplained decrease in the number of students in the Department, in the face of a larger demand than ever for its graduates, and in spite of other favorable conditions, occurred at the opening of the present session. This is perhaps due partly to the radical change of the Course in General Studies, from which good students have frequently

been recruited; partly to the diminishing number of women studying at the Institute; but mostly to causes as yet obscure. It has always been difficult to convince first-year students desiring to pursue the Course, or to persuade their parents, that Biology is a really practical subject, although students in other Courses who have reached their third and fourth years often report that, if they had understood, in their first year, what the Course in Biology is and what it leads to, they would have elected it without hesitation. Against this difficulty we shall doubtless long have to continue to struggle, in spite of the fact that we are, and for several years have been, unable to meet the demand for graduates in Biology, owing to the limited number electing the Course, and in spite of the fact that those who have taken it have readily found remunerative employment and promotion. In a technological school like the Institute some pains will doubtless have always to be taken to bring strongly before the students the opportunities offered by the more scientific as compared with the more technical Courses. It seems desirable that some way should be found to make it more generally known than it is, both by the student community and by the public at large, that the Courses at the Institute in Physics, Chemistry, Biology, and Geology are no less likely to lead to honorable and self-supporting careers for those who may elect them, than are those in Engineering.

The courses in biological subjects participated in by students from other Departments have been well attended. Industrial Microscopy, for example, draws a good number of students from the Chemical Department, and General Biology from this and from Sanitary Engineering; while the courses in Microscopical Organisms, Bacteriology, Industrial Biology, Biology of Water and Sewage, Municipal Sanitation, and Sanitary Science and Public Health, are largely attended. The short course on the Hygiene of Heating and Ventilation given to one of the Options of the fourth year of the Course in Mechanical Engineering is steadily growing in attendance, and is of somewhat exceptional interest and value.

By the introduction of the General Options in the third year opportunity has been found for a considerable expansion and improvement of the course in the History of the Inductive Sciences, given by Professor Sedgwick since 1889, chiefly to students of the Courses in Physics and Biology. In the present year the Faculty broadened the course by including in it the History of Mathematics. This part of the instruction has been put in charge of Professor Bartlett of the Department of Mathematics, the time allowed has been doubled, and the subject has been made one of the new General Options in the first term of the third year. Professor Sedgwick, during a leave of absence from March 25th last until the end of the school year, visited Sicily and southern Italy, partly to become more familiar with the field of labor of Empedocles, Pythagoras, Archimedes, Euclid, and other of the pioneers of science, and partly to get time for adequate preparation of material for the new lectures. Professor Bartlett likewise prepared during the summer, and the new course is now in successful operation with an attendance of fifty-three students. This is believed to be the first regular and complete instruction in the History of Science to be given in any American university or technical school.

Reports upon biological analyses, inspections, or investigations are often sought, and often important, for municipalities, manufacturers, corporations or individuals, and yet it is obviously impossible for officers of the Institute to make such examinations and reports in their official capacity or, if they are extensive, upon the Institute premises. To meet similar needs there have sprung up in the neighborhood of some educational institutions private laboratories, owned and directed by the officers of those institutions, but otherwise not connected with them. The numerous demands made upon the Biological Department for such aid as is described above, and the desirability of meeting these demands, have induced Assistant Professor Prescott to open during the summer a private laboratory of Industrial and Sanitary Biology and Chemistry in which such outside work can be done. Professor Prescott's laboratory

bears the name of The Boston Bio-chemical Laboratory, and is already in successful operation under his direction with the aid of two assistants technically trained at the Institute. It is believed that by the inauguration of this laboratory a real public need will be satisfactorily met, while opportunity will also be furnished in it for certain investigations in Industrial Biology and Bacteriology which could not be readily undertaken upon the premises of the Institute.

The Sanitary Research Laboratory and Sewage Experiment Station, affiliated as it is with this Department, has proved during the year of the highest service to students of Biology, and it is greatly to be desired that it shall become a permanent part of the Institute equipment, since it furnishes facilities now almost indispensable for students of Sanitary Biology, Municipal Sanitation, and Sanitary Science, not to mention those in Sanitary Engineering and Sanitary Chemistry.

W. T. SEDGWICK.

SANITARY RESEARCH LABORATORY AND SEWAGE EXPERIMENT STATION.

In the spring of the present year (1905) the sum originally contributed by the donor of the Sanitary Research Laboratory and Sewage Experiment Station,—namely, five thousand dollars a year for three years,—was generously augmented by an additional gift of five thousand dollars.

In July, two full years of actual investigation having elapsed, the first of our experiments was completed, and a large part of the summer was spent by the Biologist-in-Charge, Professor Winslow, and the Research Chemist and Bacteriologist, Mr. Phelps, in making a careful digest of the work thus far done and in preparing a Report. To this it was deemed desirable to prefix a comprehensive review of the present state of the sewage-disposal problem in England, Germany, and the United States. This report, consisting of two hundred typewritten

pages and thirty carefully prepared drawings and diagrams, is now ready for printing, and when published will constitute, it is believed, the most complete and timely report upon the theory and practice of sewage disposal that has yet appeared. It is impossible and unnecessary to epitomize here the conclusions which have been reached through our experiments, but it is believed that these already enable us to affirm the practicability of the purification of the sewage of a seaboard city, such as Boston, by means of so-called trickling, percolating, or sprinkling filters, upon an area and at an expense which need not be prohibitory. By further treatment of the effluents from these filters, with subsequent sterilization, we hope to develop a method for the cleansing of city sewage such as the donor in making the original gift desired us to find.

One of the notable events of the year is the construction and operation of a large outdoor trickling sewage filter, of ten thousand gallons daily capacity, equipped with a distributing device of original design.

The first volume of "Contributions from the Sanitary Research Laboratory and Sewage Experiment Station of the Massachusetts Institute of Technology," consisting of six papers and one map, and covering one hundred and twenty-nine pages, was published in June, and has been received with so much favor that it is already out of print. Several popular leaflets in the series begun last year upon "Dirt and Disease" have now appeared, although the publication of these was interrupted for a time by Professor Sedgwick's absence from the country. The demand for them at cost has been large and several hundred have been gratuitously distributed.

The laboratory and experiment station have continued to be of material service to the Department of Biology, and through this to the Departments of Chemistry and Sanitary Engineering of the Institute, inasmuch as students and instructors alike have here constantly an opportunity of obtaining for investigation and experiment and of experimenting upon, the sewage actually flowing away from a large seaboard city, besides

effluents in various stages of purification derived from various types of purifying processes.

The Laboratory and Experiment Station have been ably and faithfully conducted by Assistant Professor Winslow and Mr. Phelps. They have been appealed to in a number of instances during the year for practical aid in the solution of problems of importance to the public health other than those of ordinary sewage purification, notably by the United States Geological Survey, for investigations concerning the action of copper upon typhoid fever germs in water contained in copper canteens, and upon the purification of strawboard and other manufacturing wastes.

It is not easy to convey in a few words any adequate idea of the importance of a laboratory and experiment station of this kind in the educational work of a great technical school. Only those who are brought into daily contact with earnest young men preparing themselves for the arduous and intelligent work to-day required in all branches of public hygiene and sanitation can realize the immense educational value of such practical demonstrations and working facilities as are here furnished.

The heartfelt thanks of all who have had the opportunity of using the laboratory and experiment station are hereby tendered to the donor (who still prefers to remain anonymous) for its inauguration and continued support.

W. T. SEDGWICK, *Director.*

DEPARTMENT OF PHYSICS.

Several improvements in the general course of instruction have gone into effect during the past year, among which the following may be especially mentioned.

A new lecture-course upon the Electrical Discharge in Gases and Radio-Activity was given by Professor Cross during the second term of the past year. The lectures were very fully illustrated by experiments. Attendance was optional, and

they were given at a late hour in the afternoon, when the students were free from other exercises. It is intended to continue this course in succeeding years.

It has long been the desire of the Department that the instruction in the Laboratory of General Physics should begin at the middle of the second year instead of at the end of the first quarter of the third year, though until within a few years this has been feasible only for the Courses in Electrical Engineering and Physics. It is far more interesting to the student to enter upon elementary experimental work of the general character of that with which the course in Physical Measurements begins before his attention is largely concentrated upon more strictly professional work. Furthermore, an earlier start in this direction allows time in the later years for the more advanced instruction in Technical Physics which is called for in constantly increasing measure in most of the professional Courses. For over twenty years past the studies in the Courses in Physics and Electrical Engineering have been laid out so as to secure the end under consideration, and for a number of years past the same has been true of the Course in Chemistry. The Courses in Civil Engineering, Sanitary Engineering, Biology, and Geology have now been modified so as to permit of a like arrangement. The consequent overlapping of the second and third-year classes of the first-mentioned Course, which took place last spring, when the new arrangement went into effect, produced an unprecedented crowding in the laboratory, a difficulty which will not recur until a like change is introduced into some of the remaining large Courses. The inconvenience referred to was only temporary, however, while the gain from the change is very great.

A further advance is the extension of the instruction in the Precision of Measurements. This important subject now forms a part of the teaching given by the Department to students in all Courses taking work in the Laboratory except in Civil Engineering, Chemical Engineering, and Sanitary Engineering.

It is gratifying to have this fuller recognition of the value to

all professional men of a knowledge of the methods whereby they may determine the numerical accuracy of observations. While the principles referred to are naturally taught in connection with Physical Measurements, they are equally applicable to all branches of science. Moreover, an endeavor is made in the various illustrations and problems of the course to deal with engineering as well as with purely physical data.

The extension of this subject has necessarily increased the amount of class-room instruction demanded of the laboratory staff, but it is believed the results are well worth the effort.

In the Electrical Laboratory Professor Laws has introduced several modifications of the methods of instruction which have materially increased their efficiency. A number of new and refined methods of magnetic and electrical measurement have been carefully investigated with a view to adapting them for use in practical work.

The Laboratory of Heat Measurements, in charge of Professor Norton, has profited greatly by the special appropriations which have been made for its equipment and enlargement. The laboratory will shortly possess practically all standard apparatus at present employed for the maintenance and measurement of high temperatures, the study of the calorific power of fuels, the measurement of thermal conductivity, and the investigation of the effects of heat upon the materials of engineering.

Through the generosity of Mr. John W. Dunn this laboratory has been equipped with an 8″ x 4″ ammonia pump to be used in connection with our refrigerating apparatus. It is hoped that the available supply of liquid air will be such as to enable us to carry our instruction and research over much wider ranges of temperature.

In the Optical Laboratory Professor Wendell has been much hampered by the limited space which is allotted to this work. The equipment, however, is excellent, and consists of apparatus of the most recent type. The instruction in Optics during the past year was made especially valuable through the courtesy

latter permits a student to take the Bachelor's degree in the astronomical and topographic branches of Civil Engineering. These subjects have been offered in the past only as graduate work in the Department of Civil Engineering. Stress is laid on field work in both Options and the fourth-year programme is partly elective, permitting the student to specialize according to his professional aim.

In 1905 four students of the Course in Mining Engineering graduated in the geological Option of that Course. The graduation theses of these men were based on field studies in Massachusetts, Rhode Island, and Alaska. Ten students of the class of 1906 are enrolled in this Option. In 1904–5, the total registration in studies under the Department was seven hundred and eight.

Professor Jaggar was engaged during the summer in writing the text of the Geologic Folio of the Spearfish-Sturgis district of South Dakota for the United States Geological Survey. He has given some time during the past year to field experimentation with a telemeter-alidade designed for making sketch maps of small areas in geological surveying.

Professor Crosby is engaged in the investigation of the auriferous formations of Admiralty Island and the Juneau district in Alaska, and he has also examined some gold mines in Shasta County, California. The publication of his work on the Rocks of the Lower Neponset Valley marks another step in the progress of his valuable researches on the Geology of Eastern Massachusetts.

Professor Warren in the Mineralogical Laboratory has been engaged in making a mineralogical examination of river and sea sands and ores chiefly from the Pacific States under the auspices of the United States Geological Survey. A portion of his time has been occupied with economic problems connected with building stones.

Professor Johnson spent a month in the early summer in the study of drainage modifications in the headwaters of the Savannah and Chattahoochee rivers. A gift of three hundred

and fifty dollars from Mrs. Henry Pickering for the work in Topographic Geology at the Institute has made possible the purchase, mounting, and framing of maps and photographs, and the acquisition of new lantern slides. Professor Johnson gave the greater part of the summer to the preparation of this equipment. The course in Topographic Geology has been extended throughout the entire year.

Dr. Shimer visited type stratigraphic localities in New Jersey and Pennsylvania during the summer, and began work on the Cortland Quadrangle for the New York Survey. He continues his work on the fossils and fossil-bearing localities of Eastern Massachusetts. He reports many valuable additions to the paleontological collections, mostly the gifts of former students. The courses in Paleontology at the Institute are devised principally to teach students to use fossils in determining geologic horizons in the field. This work is of the utmost importance in preparation for service on state or federal geological surveys.

The Department is in need of more space, and there are four objects for which money is much needed. Three of these are collections:—namely, rocks, maps, and photographs; the fourth is the instrumental equipment of the mineralogical laboratory. The Department has an excellent collection of fossils, but the collection of rocks, especially for the courses in Petrography and Field Geology, needs continual extension, and microscopical preparations are needed in order to make it serviceable.

The gift above referred to has made possible a beginning in the selection and mounting of maps; but for the maintenance and extension of this collection a considerable outlay is required. The use of the stereopticon is in no subject more valuable for teaching than in Geology. As yet, however, the Institute can hardly be said to have the nucleus of a collection of geological lantern slides. Gifts for this purpose from those interested in the development of the geologic sciences could not be more profitably expended. Lastly, there is need for a large research microscope, for crystallographic instruments, and for platinum

vessels,—all expensive apparatus which it will require years to obtain without special aid.

T. A. JAGGAR, JR.

DEPARTMENT OF NAVAL ARCHITECTURE.

The only notable change in the Course in Naval Architecture comes from the time made available for professional work in consequence of added entrance requirements put in force two years ago. A part of that time has been assigned to the course in Differential Equations, making it sufficient for the requirements of the theoretical instruction in Naval Architecture, and in consequence there is a notable gain in efficiency of that instruction, although the number of lectures is not increased. The remainder of the available time has been applied to extending the work in Ship Design and to providing courses of lectures in Ventilation and Drainage of Ships and in Technical Chemistry, which latter will deal with the chemical nature of materials entering into the structure of the ship, their tendencies to corrode or deteriorate, and methods of preservation by painting and otherwise.

During the school year of 1904–05, numerous lectures were given by experts in ship-building and in cognate arts, and a similar course is in progress the present school year, all through the interest of Dr. Weld, who has also furnished means for members of the Department to collect materials for lectures at first hand. In addition to the advantage that students have from hearing and meeting such eminent men in the profession they have chosen, we have the further advantage of collecting in the best way information which will be applied to strengthening and broadening our own instruction. In particular may be mentioned a good beginning already made in collecting photographs and lantern slides of shipyards, ships under construction, and ship tools and appliances, from prominent yards and works both in this country and abroad.

The Course for Naval Constructors has been somewhat

changed, mainly following changes in the Course in Electrical Engineering, so as to take advantage of improvements in that Course. It may be noted that two classes of naval constructors have already been graduated from the Institute, and that twelve constructors now in active service have taken our Course. There are now seventeen constructors under instruction, six having been assigned to the Course this fall. In addition two private students are taking the parallel work of our Graduate Course in Naval Architecture which, like the Course for the constructors, leads to the master's degree. Mr. John A. Ross, Jr., of the Class of 1901, who has since graduation been employed by the Construction and Repair Department of the Navy, has been obtained to assist Professor Hovgaard in Warship Design, and will be able to give more efficient assistance than has before been available. Even with such assistance, the work in Warship Design, on account of the large number of students and the special nature of their work, remains arduous.

As has been noted in several annual Reports, the regular work of the year is supplemented during the term or in the summer vacation by practice in cutting models of ships designed by the students and by practice in mould-loft work. The latter has been carried on by a method in vogue in some of the leading American and European shipyards. For this method the lines of a ship are drawn and faired to a large scale (one inch to a foot); and from these, faired dimensions for a full-sized set of lines may be obtained with all the accuracy desired in practice. These dimensions are then used to lay down a body plan on the drawing-room floor, which has ample size for that work. The key to the process is the accurate construction of the large-scale drawing at an inch to the foot, which must be made on a surface that will not change with atmospheric conditions. Dr. Weld has provided the Department with four tables for this purpose, with tops made of a special opaque white glass that was used last year with complete success, and it is believed to be better than any material hitherto used for this purpose. It may be noted that in the model shop there were cut during

the last school year forty-five models, of which eight were made by naval constructors. Many of the models made in this shop are finished for exhibition and use in the drawing-rooms, and a number have been shown at expositions with the Institute exhibits.

The present depression of the ship-building industry is naturally reflected in the diminished sizes of the classes in Naval Architecture at the Institute. Such diminution will, doubtless, be temporary and will be followed by an increase with the revival of ship-building which has already begun. So far as known, none of the graduates of the Department has suffered from lack of employment, though a considerable number have gone over into general Engineering. When a demand for trained naval architects shall again be brisk, these men will be available with a broadened horizon that goes with a wider experience, though some part will undoubtedly succeed so well in allied branches of construction that they will not be willing to leave. The Course in Naval Architecture, like its allied Courses of Engineering, is broad and well founded, and the field for usefulness of its graduates has a corresponding breadth.

C. H. PEABODY.

DEPARTMENT OF MATHEMATICS.

The only important change in the mathematical curriculum since the publication of the last Report is the increase in the time allotted to the Elements of Differential Equations in the third year of the Courses in Mechanical and Chemical Engineering and Naval Architecture. This has been rendered possible in connection with certain general changes in the third-year work, and is of much advantage to the mathematical instruction.

While there have been no substantive changes in the mathematical entrance requirements in recent years, certain modifications have been made in the application of these require-

ments with a view to making them a more thorough test of candidates for admission to the first year. In Algebra the former single two-hour examination has been replaced by two examinations, each covering one hour and three-quarters. This has rendered it possible to cover the subject-matter more completely than previously and in better relation to its intrinsic importance. There has also been an effort to make the mathematical examinations a better test of thinking power on the part of the candidates, rather than of mere facility in mechanical execution, by including the problems and a larger proportion of simple original exercises. The proportion of failures has been increased, at least temporarily, by these changes, but can scarcely be considered abnormal, except perhaps in Algebra B. It is the belief of the Department that the requirements as represented by the present examinations do not make it unduly difficult for a candidate to secure admission if he has the mathematical aptitude essential for subsequent success in an engineering Course.

During his leave of absence for the months of March, April, and May, Professor Tyler gained some acquaintance with the aims and methods of mathematical instruction in Paris and Zürich. The present activity in the improvement of instruction in elementary Mathematics abroad is of particular interest in connection with the plans under consideration for the revision of our own courses.

H. W. TYLER.

DEPARTMENT OF DRAWING AND DESCRIPTIVE GEOMETRY.

The changes in the methods of instruction begun two years ago are now for the most part completed and the wider and better results obtained seem to justify the methods adopted.

Last March Professor Adams's notes on mechanical drawing were published in book form. The book is eight and one-half inches by eleven inches, contains two hundred and ten pages,

two hundred and forty-three illustrations, and twenty-two full-page plates. The intention in preparing it was to bring together sufficient and appropriate material to meet the needs of the regular first-year students, to permit of specialization when desirable for a particular professional Course, and to take care of students required to make up deficiencies in Mechanical Drawing. As regards the regular work, the detailed treatment of the various processes and topics which the book offers has in a measure compensated for a necessarily somewhat deficient individual instruction.

The work in Descriptive Geometry has progressed favorably. Lectures are given as usual in Huntington Hall. For this work a series of some sixty to seventy wall charts, four feet by five feet, will have been prepared by the end of this year. The lectures are supplemented by printed notes and cuts. During the past summer there was prepared and printed a set of study plates in Descriptive Geometry containing some twenty-five sheets of data.

An important step was taken this year in the forming of a class in Descriptive Geometry for students entering with advanced standing. Heretofore these men have been obliged to make up deficiencies as best they could, often beginning with the second-year class at a point two-thirds through the subject and making up the preceding portion by tutoring or attendance in the first-year class. The result has been for obvious reasons generally unsatisfactory. In the special class, held daily, except Saturday, after four o'clock, the subject is taken up at the beginning and the whole ground is quickly covered in the first term. Some twenty-eight students joined the class. Attendance and interest in the work have been thoroughly satisfactory, and it is expected that there will be a marked proportional increase in the number passing the subject.

The special difficulty which the first-year class has in mastering Descriptive Geometry should again be pointed out. This difficulty appears to be due to lack of imagination on the part of the student, coupled with insufficient time for the subject

and too little individual teaching. The subject is taught from the standpoint of its application in engineering and architectural drawing. The methods followed in the lectures are those believed to be most readily assimilated by the beginner, and correspond in the main to those adopted in the French schools. The subject, however, is at best difficult for the beginner. The student's lack of imagination,—the kind necessary to visualize the solution of geometrical problems in space,—is probably due to the entire absence of preparatory training calculated to develop this power. Perhaps in no other subject is the want of preparation so keenly felt. The remedy appears to be an entrance examination in Projections, which might also include a requirement in elementary instrumental execution. As bearing upon such a requirement may be quoted a recent remark of the State Agent of Drawing: "When the Institute requires an entrance examination in drawing, the demand will undoubtedly be met." As to individual instruction, there should be enough teachers to make it possible to divide the class into sections of not more than twenty students each without giving too many sections to an Instructor. The number of teachers at present is nearly twenty per cent. less than it was two years ago. The smaller class this year makes the loss less noticeable, but much which might be accomplished with a larger teaching force must be left undone. This is particularly the case with the written criticism which should be placed on all drawings and exercises. It is desirable that a way be found to lighten the work of the teachers, and to make the compensation such as will enhance their interest in the Department as well as make it possible to secure the best men to fill vacancies. On the whole it may be said that results are as good as can fairly be expected under present conditions of equipment and teaching force.

Attention may again be called to the poor equipment of the Department. Huntington Hall is for several reasons not suitable for the lectures. The main drawing-room, which is used by some three or four hundred students, including all

sections, is the worst lighted of any drawing-room in the Institute. Many of the drawing tables are of an inconvenient, obsolete type. Cases are needed in which to place the drawing models now scattered about the room. More models and of a better type are needed, and also a blue print outfit. A large number of examples of drawing to be placed on the walls await framing. An improved equipment would materially assist the teachers in the performance of their work.

During the past year Messrs. Eugene S. Foljambe and J. Russell Putnam have resigned. Their places are filled by Messrs. Stephen A. Breed, S.B. '94, and Samuel E. Gideon. The latter is engaged for half time.

CHARLES L. ADAMS.

DEPARTMENT OF MECHANIC ARTS.

The total number of students receiving instruction in the Mechanical Laboratories is three hundred and thirty-one. Some of these attend in more than one class, the numbers attending in the several subjects of the first term being as follows:

Carpentry and Wood Turning, II.	92
Joinery and Pattern Work, VI.	43
Forging, II. and XIII.	91
Metal Turning, VI. and VIII.	46
Machine Tool Work, II. and XIII.	68
Pipe Fitting, XI.	6
Total in classes	346
Students taking work in two or more classes, and counted more than once	15
Total number of students	331

The total number of students attending last year was three hundred and fourteen. Many students have been excused from attending the Carpentry, Wood Turning, and Forging classes, and a smaller number from Pattern Work, on account of satisfactory work done in preparatory manual training schools.

The proportional number of excuses granted in these earlier subjects is increasing from year to year, but very few students come sufficiently well prepared to permit excuse in the later subjects of Chipping and Filing and Machine Tool Work.

The attendance in the Summer School was forty-eight, a number which shows a falling off of twenty-two as compared with the maximum attendance reached last year. The numbers in the several classes were—

Wood Work	9
Forging	10
Chipping and Filing	3
Machine Tool Work	26
Total	48

The proportionally large attendance in Machine Tool Work will probably continue, on account of the tendency of third-year students of Courses II. and XIII. to anticipate the Mechanic Arts of the fourth year, and thus to secure free time for thesis or other departmental work.

No additions have been made to the equipment during the past year. To maintain the present high standard of work fourteen engine-lathes and a planer purchased in 1876 should be replaced by new and modern machines. A universal grinding machine, a universal milling machine, and a small radial drill are very much needed to carry on successfully the general class-work in the Machine-Tool Laboratory.

The renewal of the equipment in the Forging Laboratory, while desirable, is not recommended, on account of the probable early removal of the Mechanical Laboratories to a new location.

Instruction ampitheatres have been provided in the Wood Working, Forging, and Chipping and Filing Laboratories, and have been found a very great convenience to both students and Instructors.

As stated last year, it is believed that instruction in Foundry Work should be given to every student in Mechanical Engineering, because of the value of a thorough knowledge of this im-

portant subject in many industrial works. The course is now optional and the large classes show a demand for this training. It is again earnestly recommended that a new and larger melting plant be installed, as under present conditions it is extremely difficult to obtain good results. With a larger and improved plant the students might make many of the castings now purchased outside. Should the course be required of students in Mechanical Engineering, an additional Instructor would be needed.

A much-needed improvement has been made in the roof of the laboratory building. The ventilation has been decidedly improved, leakage obviated, and the lighting remains nearly as good as formerly. To remedy still further faulty former conditions an electric lighting plant should be installed in place of the present inadequate gas lighting system, and a new solid plank floor should be laid in the Machine Tool Laboratory.

PETER SCHWAMB.

DEPARTMENT OF ENGLISH.

Several changes have been made during the past year in the details of instruction in English. The distribution of time in the second term of the first-year course in English was altered so that the time allotted to the subject—two hours a week—was all used in the class-room. The result has been most satisfactory. The study of literary form in preparation for second-year Literature was carried forward more successfully than ever before; and the change will be adopted permanently.

The first-year class was also given a drill of two weeks in the use of books of reference. The machinery of this drill need not be described in detail; it is sufficient to say that the effort has been to make the students actually use as many reference-books as possible, and to call their attention to all others in the Library.

During the present term an application of what may be called the laboratory method is being made to the first-year English of the first term. An hour of the time hitherto given to preparation has been added to a recitation period, to make a period of two hours. This is used for the writing of a fairly long theme in class, under the general supervision of the Instructor, the work being required within a given time. This method trains the student in readiness and promptness, and is in the end a time-saving device in that it makes impossible all dawdling, doubting, and indecision. It is too soon to speak with finality of the value of this laboratory method; but the results thus far are most promising.

In the matter of entrance examinations the English Department has taken a new step by breaking away definitely from enforced compliance with the list of the Commission of Colleges in New England. The enthusiastic approval of this move, as expressed in letters received from the heads of fitting-schools, shows that it is at least a step in the direction in which the best thought is moving.

ARLO BATES.

DEPARTMENT OF HISTORY.

There has been no marked change in the work in History required of all regular first-year and second-year students, and of fourth-year students in Architecture. The discontinuance of the Course in General Studies was naturally accompanied by the discontinuance of instruction in the subjects given in that Course only; but the introduction of Options in General Studies in the third year has offered an opportunity to establish new courses in History and Government. These are somewhat briefer and more general in scope than those formerly given in Course IX., but reach a considerably larger number of students.

CHARLES F. A. CURRIER.

DEPARTMENT OF ECONOMICS, STATISTICS, AND POLITICAL SCIENCE.

As a result of the changes in the allotment of time in the third year, the required instruction in Political Economy is now compressed into the first term, the class meeting three times a week instead of twice as in former years. It is believed that this arrangement will be advantageous, as it secures concentration of attention and interest.

The instructors in this Department are developing the practice of individual conferences with students, and it is hoped to emphasize still further this part of the course.

DAVIS R. DEWEY.

DEPARTMENT OF MODERN LANGUAGES.

The work of the Department of Modern Languages has been carried on substantially on the lines indicated in the last annual Report. Attention has been directed chiefly to the proper proportioning of oral and written work, and to giving students a symmetrical training in the directions of pronunciation and conversation on one side and of reading and translation on the other. The number of text-books has been diminished, and the vocal use of the languages encouraged.

Students admitted to the courses in Modern Languages have generally had little or no training in pronunciation. With a view to repairing this deficiency, the recitation rooms of all the French sections have been equipped with charts giving exercises for practising pronunciation. Students are marked separately on pronunciation and on other work, and given the mean of the two as a general or record mark. A thorough inquiry has been made into the various graphophones or talking machines that are offered for sale as aids in imparting and acquiring pronunciation, and the purchase of a number of such machines

of a particular pattern for the use of the Department is likely to be recommended.

In addition to pronunciation charts and talking machines, the section rooms should, if practicable, be provided with simple pictures to which the teacher might point to designate objects which he wishes to bring to the minds of the students without making use of English; such pictures as are especially designed for class-room use, as the German "Anschauungsbilder." These and such other objects as foreign calendars, posters, and photographs might help materially to make the courses in Modern Languages more instructive. Mechanical and other technical drawings are especially needed. The text-books in common use in scientific reading are very defective in respect to illustration.

The number of students who failed to meet the entrance requirements in Languages made it expedient to provide instruction for them in French I. and German I. It is expected that the same condition will obtain next year.

At the beginning of this school year a section was formed in Italian, but had to be abolished, as the only available Instructor, Mr. Erhardt, had to give his whole time to other languages. In view of this fact, the increasing demand for Spanish, and the present size of the sections, it appears that the Department has, or soon will have, employment for an additional Instructor.

The work devolving upon the several Instructors has been performed with zeal and efficiency. Professor Vogel edited and published through Heath and Company a German reader entitled "Geschichten aus der Tonne," by Theodor Storm.

JOHN BIGELOW, JR.

Reports of Administrative Officers.

REPORT OF THE SECRETARY OF THE FACULTY.

The Faculty business of the year has consisted largely in the conclusion of certain curriculum changes to which reference has been made in previous Reports, and in the preparation of a report to the Corporation on the Proposed Agreement with Harvard University.

The changes of the curriculum, now in operation for all classes except that of 1906, have comprised the substitution for two hundred and seventy hours' work in French or German of one hundred and twenty hours in elective work in Economics, English, Modern Languages, or History (including History of Science), and of the remaining one hundred and fifty hours in professional subjects. This has fortunately not meant as a rule an increase in the number or variety of professional subjects, but rather the allotment of more time to those already included. The changes have affected primarily the third year and to a less extent the second and fourth.

The distribution of third-year students among the several General Electives for the present term is as follows: Economic History, 37; Advanced English Composition, 9; English Literature of the Eighteenth Century, 35; French III, 7; German III, 17; French Sight Reading, 15; German Sight Reading, 15; Spanish, 75; Comparative National Government, 14, International Law, 62; History of Science, 53.

One of the principal difficulties in the whole arrangement consisted in the reservation of hours for the electives which would admit of the participation of students from all Departments. It was found practicable to reserve a single hour in

the Tabular View for this purpose, subjects requiring more than one hour being then relegated to the 4–5 P.M. period for the remainder.

Among other departmental changes may be mentioned the further development of the Geological Option (3) in Mining Engineering and Metallurgy, in which there are this year nine candidates for graduation; the announcement of the discontinuance of Landscape Architecture as an undergraduate Option; important changes in the Courses in Chemistry and Chemical Engineering; and the remodelling of Course XII (Geology) into a Course in Geology and Geodesy. Fuller details in regard to these changes may be found under the respective departmental reports.

A change in connection with requirements for graduation, particularly affecting candidates who fall short of completing the Course in four years, is embodied in the following rule adopted by the Faculty:

"The degree of the Institute represents not only the formal completion of the subjects in the selected Course of study, but also the attainment of a satisfactory standard of general efficiency. Any student who does not show in the fourth-year work of his Course that he has attained such a standard may be required before receiving the degree to take such additional work as shall test his ability to reach that standard. This additional work shall consist in the preparation of a thesis during the last term of residence, unless otherwise provided by a special vote of the Faculty, and in the pursuance of such new studies and the repetition of such of those previously taken as may be required by the Faculty; and, in general, an amount of work per term substantially equivalent to that involved in the regular Courses of study will be required during any subsequent period of residence."

The entrance requirement in Physics announced last year has become operative for the present first-year class. The examinations of the present year were made relatively simple, and the proportion of failures was not unexpectedly great. It

is hoped that preparatory work in this subject will be favorably affected by the Institute requirement.

The attention of the Faculty during the spring was largely occupied with the consideration of the proposed agreement with Harvard University, which was exhaustively discussed in all its bearings at numerous meetings, both of the entire Faculty and of the special committee of heads of Departments to which the matter was referred. The report of the Faculty to the Corporation has been published in an extra issue of the *Technology Review* for April, 1905.

The Secretary having been granted leave of absence from March 1st, the administrative work in his charge was most efficiently conducted by Professor Merrill as Acting Secretary, with the co-operation of the other administrative officers and of Professor Currier and Mr. Robinson. It has fortunately proved possible to secure Professor Merrill's services as Acting Dean during Dean Burton's absence.

H. W. TYLER, *Secretary.*

REPORT OF THE DEAN.

The work of the Dean's office for the past year has been of the same general character as that of the two preceding years, with a noticeable increase in the number of students voluntarily consulting the Dean. During the absence of Dean Burton in Europe the work is being carried on along the lines which he has so successfully followed in the past.

As in previous years, each new student has been assigned to some member of the Instructing Staff, who acts as his adviser. So far as possible these assignments were made on the two days immediately preceding the opening of the term, when members of the Committee of Advisers met new students in the General Library for the purpose of assisting them in the arrangement of their programmes of work and in registration. It was intended that during this time there should always be present

one or two members of each professional Department, as well as members of the Faculty Committees on First-Year Students, Five-Year Students, and Provisional Students, so that special advice might readily be obtained.

The usual notes of inquiry were sent to the principals of the preparatory schools last attended by new first-year students, and the replies received were in many instances helpful to a better understanding of the needs of the student concerned, or a fairer estimate of his ability.

The Walker Club, following its precedent of last year, gave an informal reception at the Technology Club, to which all students entering the Institute from other colleges were invited. About seventy-five men took advantage of this opportunity to meet members of the Faculty and to become acquainted with each other.

The room and boarding-house register, comprising a list of two hundred and thirty-five houses in Boston and its immediate suburbs, was consulted by a much larger number of students than in the past year, and a seemingly greater number of men found accommodations outside of the city proper.

The employment bureau was more successful in finding employment for under-graduates during the past year than in the previous year, although the work offered was seldom in the line of their professional Courses at the Institute. There were in all about fifty applications for student help from persons not connected with the Institute. A few of these opportunities were for work during the school year, but the greater number were for the summer. In almost every instance we were able to supply the desired assistance, although the nature of the work was varied and included applications for chauffeurs, draftsmen, book agents, tutors, and hotel help. Thirty-five students asked for aid in finding employment during the school year, and one hundred and ten made application for summer work.

Gymnasium.—The work in the gymnasium has, in general, been carried on along the same lines as last year, but the attendance has been larger and much more regular. More attention has been paid to heavy gymnastics than in the past, and a team has been formed which gave two very successful exhibitions. The development of this branch added interest to the regular work and was a large factor in increasing the attendance. The Track Team and the Basket Ball Team used the gymnasium two days a week and called out a large number of men.

Physical examinations were given, at the beginning of the year, to each man intending to take regular class work, and the exercises were laid out on the basis of these examinations. A second examination was given at the end of the year, and in all cases there was marked improvement. The Cabot Medals for Improvement in Physical Training were awarded to G. B. Mayer, '05, A. T. Heywood, '06, A. H. Keleher, '06, A. E. Hartwell, '07, and H. G. Pastoriza, '07. The committee of award, consisting of Professors Wendell and Bailey, Mr. Towne and the Dean, decided on account of the large number of contestants and their high percentage of gain to award five medals this year instead of three as last year.

The lease of the land on which our Exeter Street Gymnasium was situated ran out on May first and, as the lessors, desiring to use the land themselves, did not wish to renew, other quarters had to be secured. After careful consideration the Institute decided to build a gymnasium on the Garrison Street property, next to the Mechanical Laboratories. The new gymnasium, which was built during the summer and early fall, is an entirely suitable building and is well adapted for our present needs. Its decided superiority over the old gymnasium should be a great stimulus to a more widespread interest in gymnasium work at the Institute.

STATISTICS OF ILLNESS FOR THE SCHOOL YEAR 1904-1905.

Fourth-year Class.

There were three hundred and forty students, regular and special, in the fourth-year class. Of these twenty-five were reported ill during the school year 1904–1905. Classified by diseases, there were the following cases: appendicitis, 1; acute mental exhaustion, 1; diphtheria, 1; eye trouble, 2; general debility, 1; grippe, 5; jaundice, 1; severe cold, 3; tonsillitis, 1; typhoid fever, 2. In seven cases the illness was not specified.

Third-year Class.

The whole number of students in this class was four hundred and twenty-five. Of this number thirty-nine were reported ill during the school year 1904–1905. Classified by diseases, there were the following cases: abscess, 2; appendicitis, 1; carbuncles, 1; catarrhal trouble, 1; eye trouble, 6; grippe, 5; injury to hand, 1; lung trouble, 1; mumps, 1; neuralgia, 1; nervous trouble, 3; rheumatic fever, 1; severe cold, 1; tonsillitis, 2; eleven cases were not specified.

Second-year Class.

The regular and special students in this class numbered three hundred and sixty-one. Forty-six of these were reported ill during the school year 1904–1905. Classified by diseases, there were the following cases: appendicitis, 2; bronchitis, 1; carbuncle, 1; compound fracture of arm, 1; eye trouble, 1; fever, 3; diphtheria, 1; grippe, 8; indigestion, 3; knee trouble, 1; nerve exhaustion, 1; pharyngitis, 1; pneumonia, 1; rheumatic fever, 1; septic finger, 1; tonsillitis, 2; typhoid fever, 1; whooping-cough, 1; there were four cases of less serious nature, and nine unspecified cases.

First-year Class.

The first-year class numbered four hundred. Of this number thirty-eight were reported ill during the year. Classified by diseases, there were the following cases: abscess, 2; appendicitis, 1; broken leg, 1; chicken pox, 1; carbuncle, 1; fever, 1; grippe, 2; hemorrhage, 1; measles, 1; malaria, 1; mumps, 1; pneumonia, 1; severe cold, 2; sore throat, 1; sprained ankle, 1; tonsillitis, 7; trouble with eyes, 4; ulcerated tooth, 2; operation, 1. Six cases were unspecified. There was one death in this class, that of Mr. J. F. Leonard, on October 31st, due to pneumonia.

SUMMARY.

	No. in Class.	*No. Ill.*	*No. of Deaths.*
Fellows and Graduates	32	—	—
Fourth Year	343	25	—
Third Year	425	39	—
Second Year	361	46	—
First Year	400	38	1
	1,561	148	1

A. L. MERRILL, *Acting Dean.*

REPORT OF THE MEDICAL ADVISER.

There have been no important changes in the work of the Medical Adviser during the past year. Office hours have been held in the Pierce Building twice a week throughout the school year, and the time set apart for medical visits has been fully utilized.

The work of the Medical Adviser, which was begun in 1902, increased rapidly and steadily during the years 1903 and 1904 as the students became accustomed to the new arrangement and took advantage of it. In January, 1904, it was found that more students came for advice at every office hour than could be seen between four and five o'clock, and, in order to provide for this increased number of students, the time of consultation was extended when necessary, so that each student who came for advice should get it. The new plan has been continued throughout the past year.

The following table gives the number of office visits made, and the number of students seen. A few figures for the year 1903 to 1904 are given for comparison.

	1904.	1905.
Total number of office visits made	349	406
Total number of different students seen	185	191
Greatest number of students seen per day		12
Least number of students seen per day		2
Average number of students seen per day	6	7
Number of students making more than one visit		60

The moderate increase in the work in the last year, in comparison with the rapid annual increase in previous years, seems to indicate that the time at present devoted to giving medical advice to the students is practically sufficient, and that the work of the medical office is at or near its maximum.

All the patients were men, and usually most of them found it necessary to come only once, for the treatment of some acute condition. Only seven men made more than five visits apiece. Six of these were surgical cases requiring frequent dressings, and one, a man of poor constitution, who was advised to leave the Institute.

There is no abuse of the medical office by the students. Those who ask for advice have a definite ailment. It seems characteristic of the men that they do not waste time over imaginary ills. The practice of asking the Medical Adviser for excuses from class-work without sufficient reason, which is sometimes met with in our colleges, is practically unheard of at the Institute. Even excuses from drill are very rarely asked for, and almost invariably with good and sufficient reasons.

On the other hand, occasionally a man is found, who, in his enthusiasm for work, does not take very good care of himself, neglects physical exercise, and cuts short his sleep. These mistakes in hygiene are not the necessary consequences of the Institute course, but rather the results of the student's own carelessness or poor judgment as to how to get the most out of himself.

The records of the gymnasium attendance show clearly that many more students living in or near the city proper could use the gymnasium regularly with great benefit to themselves, particularly during the winter months.

The most frequent conditions treated were diseases of the nose and throat, digestive disturbances, and minor surgical diseases. About a dozen men suffered from severe illnesses, such as pneumonia, grippe, pleurisy, appendicitis and Bright's disease. Two men had to leave the Institute on account of

pulmonary tuberculosis. Almost all the illnesses, however, were acute and promptly curable.

A small number of students were referred to specialists for treatment of the eye, ear, and skin. A small number of students were sent to the Massachusetts General Hospital for treatment of such acute diseases as pneumonia, pleurisy, grippe, appendicitis, et cetera, while others were taken care of at small private hospitals.

When we consider the fact that between eight hundred and nine hundred Institute men are living away from home in Boston and its suburbs under conditions which render it almost imperative to go to a hospital in case of illness, and that at least fifty men each year (counting those seen by the Medical Adviser, and those reported by other physicians) suffer from severe illnesses, it may be worth while to consider the possibility of having a small Institute hospital or infirmary to care for our own students.

It would be a great help to the Medical Adviser in keeping informed about the health of the students if each man who is absent from class-work for more than a day on account of illness, should be required to present on his return a card signed by his physician, if he has one, stating what the illness has been. Occasionally the reports sent in by sick students to explain their absence are very informal.

In addition to the work at the Institute office, I have seen about fifty men at my private office, and have been called to attend a smaller number at their houses.

The number of contagious diseases among Institute men is very small. During the last year two cases of mumps, one of measles, one of diphtheria, one of chicken-pox, and one of whooping-cough were reported. This small number of contagious cases is probably the result of the scattered residences of our men and our insistence on the necessary period of isolation after a contagious illness.

In addition to students who were sick, fifteen men were examined for the United States Civil Service or for athletic teams.

Three talks on personal hygiene were given by the Medical Adviser to the whole first-year class, covering the following subjects:—bathing; exercise; care of the eyes; the use of tobacco and alcohol; minor ailments, such as constipation, headaches, colds, etc., and emergencies; also the prevalence and dangers of venereal disease.

FRANKLIN W. WHITE, M.D., *Medical Adviser.*

THE LIBRARIES.

The number of gross accessions to the Libraries of the Institute during the year 1904–05 is 4,915, as follows:—

TABLE OF GROSS ACCESSIONS CLASSIFIED BY SOURCES.

By Purchase	1,161
By Binding	927
By Gift	1,827
Total	4,915

The cost of these accessions and of placing them upon the shelves, exclusive of salaries, etc., as shown by the bills approved in this office, amounts to the following:—

Books and Binding	$4,462.72
Periodicals	1,910.32
Supplies	175.87
Total	$6,548.91

After deducting losses and books counted twice, the net increase in the Libraries of the Institute amounts to 3,943 volumes, 707 pamphlets, and 193 maps; making the total contents of the Libraries 71,304 volumes and 20,458 pamphlets and maps. The particulars of the growth of the several Libraries in volumes, pamphlets, and maps, with the amount expended for each library, and the present total contents are shown in the following table:—

TABLE OF THE NET INCREASE WITH THE COST OF THE SAME DURING THE YEAR 1904–05, AND THE TOTAL CONTENTS OF THE LIBRARIES OF THE INSTITUTE, SEPT. 30, 1905.

LIBRARIES.	Net Increase.				Total Contents.	
	Volumes.	Pamphlets.	Maps.	Cost.	Volumes.	Pamphlets and Maps.
General Library:						
General	262	254	—	$169.42	6,882*	4,981
English	87	—	—	124.91	3,315	44
Military Science	2	2	—	2.00	334	9
Walker Memorial	106	—	—	—	477	—
Drawing	6	1	—	34.86	28	1
Totals General Library	463	257	—	$331.19	11,036	5,035
Architecture	269	5	—	150.87	3,805	241
Biology	100	3	—	179.42	3,126	620
Chemistry	445	53	—	666.65	9,827	1,804
Electrical Engineering	197	9	—	378.87	1,018	42
Engineering	520	143	—	906.38	11,935	4,442
Geology	112	81	193	100.93	2,654	2,678
History and Economics	422	47	—	396.94	11,507*	3,564
Margaret Cheney Room	—	—	—	20.60	670	13
Mathematics	105	6	—	229.16	1,495	214
Mining	243	24	—	373.39	3,907	653
Modern Languages	507	20	—	68.19	1,610	49
Naval Architecture	350	39	—	233.39	1,059	104
Physics	210	20	—	426.74	7,655	999
Totals	3,943	707	193	$4,462.72	71,304	20,458

The list of periodicals and other serial publications taken by the Institute has been increased during the past year by 17, making the total number now currently received 961. The following table shows the number and cost of the serial publications charged to each account and for each Department:—

* 1,025 volumes transferred from History and Economics to General.

TABLE OF PERIODICALS AND OTHER SERIAL PUBLICATIONS RECEIVED DURING THE YEAR 1904–05, CLASSIFIED BY DEPARTMENTS AND METHOD OF PAYMENT.

LIBRARIES.	Number Received.					Estimated Cost.			
	Gifts.	Charged to Department.	Periodical Account.		Totals.	Dept. Account.	Periodical Account.		Totals.
			Exch.	Subs.			Exch.	Subs.	
General	34	14	18	23	89	$43.38	$36.00	$69.39	$148.77
Architecture	8	9	2	32	51	41.69	4.00	150.04	195.73
Biology	7	10	14	33	64	30.66	28.00	233.97	292.63
Geology	12	3	3	7	25	20.64	6.00	38.69	65.33
Chemistry	15*	40	17	30	102*	133.53	34.00	171.63	339.16
Engineering	38	56	63	65	222	165.21	126.00	225.73	516.94
Electrical Engineering	5	12	9	4	30	44.55	18.00	24.10	86.65
History and Economics,	53	42	2	41	138	83.05	4.00	139.69	226.74
Mathematics	—	2	—	17	19	2.05	—	71.68	73.73
Mining	9	9	37	28	83	23.45	74.00	121.50	218.95
Modern Languages	3	2	—	17	22	4.91	—	74.16	79.07
Naval Architecture	4	9	5	6	24	43.83	10.00	19.08	72.91
Physics	16	16	22	21	75	66.67	44.00	74.19	184.86
Walker Memorial	9	—	—	—	9	—	—	—	—
Military Science	1	1	—	1	3	2.00	—	2.65	4.65
Margaret Cheney Room,	4	1	—	—	5	1.50	—	—	1.50
Totals	218	226	192	325	961	$707.12	$384.00	$1,416.50	$2,507.62

During the year 7,625 cards were added to the General Catalogue, and a like number distributed to the Departmental Catalogues. The total number of entries in the General Catalogue now amounts to 73,159. There were issued 2,020 orders for the purchase of new books and periodicals, and 1,303 orders for binding.

In 1899, which was the end of the tenth year after the establishment of the Library as a separate administrative Department of the Institute, a report was made, showing the growth of the Library for the 10 years, and now, in view of the discussion which has been invited in regard to the future needs of the Institute, it seems desirable to continue these statistics to the present time. The following table shows the growth of the Library as a whole for the six years from 1899–1900 to 1904–05. During this time the Library has increased by 21,155 volumes, making a yearly average of 3,526,

* Not including Experiment Station Reports.

or 4.95 per cent. of the present contents, as against an average growth during the previous 10 years of 3,260, or 4.6 per cent. of the total contents in volumes.

GROWTH OF LIBRARIES DURING SIX YEARS ENDING SEPT. 30, 1900–1905.

	1900	1901	1902	1903	1904	1905
Net Accession: Volumes	3,702	3,567	3,309	3,545	3,089	3,943
Total Volumes September 30 . . .	53,851	57,418	60,727	64,272	67,361	71,304

Average 1900–05 3,526 = 4.945% of 71,304
Average 1890–99 3,260 = 4.572% of 71,304

For the purpose of determining the needs of the Library in the future, it is more important to know the growth of the separate Departmental Libraries, and this is shown for the last six years in the following table:

DEPARTMENTAL LIBRARIES.
ANNUAL INCREASE IN VOLUMES, 1900–1905.

LIBRARIES.	Average.	Per cent.	Maximum.	Minimum.
General	569.8	5.2	740	431
Architecture	226.5	6.0	323	174
Biology	156.8	5.0	245	100
Chemistry	378.5	3.8	445	323
Electrical Engineering (2 years, 1903–04 and 1904–05) .	186.5	18.3	197	176
Engineering	637.0	5.3	779	520
Geology	120.5	4.5	143	96
History and Economics	504.6	4.4	653	412
Mathematics	98.1	6.6	129	75
Mining	263.6	6.7	350	196
Modern Languages	161.3	10.0	507	24
Naval Architecture (1 year, 1904–05)	350.0	33.1	350	350
Physics	268.3	3.5	333	210

It will be noticed that the growth has been on the whole steady, the growth of most of the Departmental Libraries being between 4 per cent. and 6 per cent. of their present con-

tents. Two of the Libraries, Electrical Engineering and Naval Architecture, have been established very recently; the one only three years ago, the other only two years ago, and their growth is naturally at present much more rapid. If they had increased during the six years at the rate that they have increased as shown in the table, the average for the six years for the Library as a whole would have amounted to 3,930 volumes. These tables show that the Libraries may be expected to increase by 50 per cent. of their present contents within the next 10 years, or to double in size in the next 20, and as the Libraries now are all filled practically to the full capacity of their shelves, it will be necessary to add a corresponding proportion of shelf room to that already provided.

In this connection it may be of interest to compare the contents of the Library of the Institute with that of other similar institutions. Data for the current year are unfortunately wanting, but in the following table the position of the Institute at the present time is compared with that of 14 other technical schools in this country, as given in the first volume of the Report of the U.S. Commissioner on Education for 1903, pp. 764 to 1017.

LIBRARIES OF THE AMERICAN SCHOOLS OF TECHNOLOGY EXCEEDING 6,000 VOLUMES.

1.	Massachusetts Institute of Technology (1905)	71,304
2.	U.S. Military Academy	50,000
3.	U S. Naval Academy	44,650
4.	Kansas State Agricultural College	27,210
5.	Mass. Agricultural College	24,258
6.	Michigan Agricultural College	24,003
7.	Colorado State Agricultural College	19,000
8.	Michigan College of Mines	18,060
9.	Armour Institute of Technology	16,279
10.	Virginia Military Institute	12,509
11.	Purdue University	12,206
12	Rose Polytechnic Institute	10,000
13.	Stevens Institute of Technology	9,000
14.	Rensselaer Polytechnic Institute	6,787
15.	Colorado School of Mines	6,437

While the Institute stands at the head of the American technical schools in the size of the Library, it also holds a very

respectable position when compared with the foreign schools, for which we have data taken from *Minerva* for 1905–06. Unfortunately no data are available for Paris, but in the other technical schools listed below it will be found that the Institute occupies at least the sixth place in size of library. The figures for St. Petersburg are, however, somewhat doubtful.

LIBRARIES OF SOME FOREIGN TECHNICAL SCHOOLS COMPARED WITH M. I. T. LIBRARY.

1.	St. Petersburg, Mining Inst. of Katherine II.	250,000
2.	Hanover, Technische Hochschule	163,000
3.	Vienna " "	94,912
4.	Berlin, Technische Hochschule, Charlottenburg	86,000
5.	Budapest, Polytechnikum	76,469
6.	Boston, Massachusetts Institute of Technology	71,304
7.	Aachen, König. tech. Hochschule	60,200
8.	Dresden, Kŏnig. Sächs. tech. Hochschule	46,606
9.	St. Petersburg, Highway and Hydraulic Eng'g Inst.	40,000
10.	Stockholm, K. Tekniska Högspolan	24,600
11.	Brünn, Kais. Konig. deut. tech. Hochschule	27,120
12.	St. Petersburg, K. Nikolaus, Inst. für Civilingenieure	12,500
13.	Naples, Reg. Scuola d' Applicazione per gli Ingegneri	7,000

Compared with American Universities and Colleges, other than technical schools, the Institute holds the 18th place, as shown by the list given below.

LIBRARIES OF UNITED STATES UNIVERSITIES AND COLLEGES EXCEEDING 50,000 VOLUMES. (1903).

1.	Harvard University	607,100
2.	University of Chicago	367,000
3.	Columbia University	362,000
4.	Yale University	350,000
5	Cornell University	285,000
6.	Princeton University	268,000
7.	University of Pennsylvania	224,000
8.	Brown University	140,000
9.	University of California	126,000
10.	University of Michigan	123,362
11.	Johns Hopkins University	115,000
12.	University of Minnesota	111,570
13.	Dartmouth College	100,000
14.	Lehigh University	84,657
15.	Georgetown University	83,956
16.	University of Wisconsin	78,600
17.	Bowdoin College	76,240
18.	Massachusetts Institute of Technology (1905)	71,304
19.	University of Notre Dame	70,000
20.	Western Reserve University	68,500

21.	University of Vermont	66,000
22.	Oberlin College	63,715
23.	Wesleyan University	63,000
24.	Syracuse University	62,000
25.	Amherst College	60,000
26.	University of Illinois	57,594
27.	Wellesley College	56,328

It is impracticable to preserve statistics showing completely the use of the Libraries of the Institute, but the following figures will give some information on that point:

CIRCULATION.

General Library	1,343 vols 289 pamphlets and periodicals
Biological	211 vols.
Chemical	1,586 vols.
Engineering	1,381 vols. 237 pamphlets and periodicals
Mining	737 vols. for home use 916 vols. for reference

For the General Library the attendance in the evening has been noted. The total attendance for the 154 days from October 4, 1904, to June 1, 1905, was, during the hours from 5 to 7, 1,389; from 7 to 10, 555, making a daily average of 9 for the first period, and 3.6 for the second.

As already stated, the total number of gifts received by the Library has amounted to 1,827 volumes, pamphlets, and maps. Among these may be noted: 106 volumes received for the Library of the Walker Memorial, from Frank Harvey Cilley, Class of '89, making a total of 477 volumes which he has contributed to this library. By his death the Institute has lost a benefactor who took a very personal interest in her welfare. Mr. Cilley began his contributions to the Library in the fall of 1902, after consulting with the Dean and the Librarian as to the best methods of making his gift. These books were all selected by him personally, and most of them were examined by him carefully before they were sent to the Institute. They include a considerable range of subjects, dealing not only with gymnastics and athletic sports, but also with out-door life in general; with hygiene, physiology and anatomy, an under-

standing of which Mr. Cilley deemed essential for a pure and wholesome life.

Dr. Charles O. Weld, of the Corporation, is credited on our record of accessions with 165 volumes. A portion of these, however, were reported in the previous year as part of the Bryant collection, but had not then been entered in our record of accessions.

We have received from President William R. Harper, of the University of Chicago, 10 volumes of the University of Chicago Decennial Publications.

From Samuel Cabot, Esq., of the Corporation, 31 volumes of books on Chemistry have been received.

From Mrs. Thomas Oakfield we have received a collection of books belonging to the library of her husband, consisting of 19 manuscript books containing copies of letters, correspondence, and notes on the manufacture of glass, and relating to Mr. Oakfield's experiments in photography and the action of sunlight on glass; of 34 volumes of bound pamphlets, containing the published essays of Mr. Oakfield on the action of sunlight on glass, and pamphlets of other authors on related subjects. Among the printed books were 31 volumes on stained glass, ceramics, decorative art, etc.; 18 volumes on glass making, including 141 volumes of considerable historic interest; 7 volumes on other industrial arts; 24 volumes on Chemistry and Physics, including books on light and color; 18 volumes on Mineralogy and precious stones; 6 on Microscopy; and 24 on science and art.

From Mr. John Alden, Class of '77, we have received Ostwald's Allgemeine Chemie, 2 volumes; Moniteur Scientifique, 11 volumes; and the Encyclopédie Chimique, 17 volumes.

ROBERT P. BIGELOW, *Librarian.*

REPORT OF THE REGISTRAR.

The Catalogue, this year, shows the total number of members of the Instructing Staff in all grades to be one hundred twenty-five, inclusive of those concerned with the Mechanic Arts, but exclusive of the Research Associates and Assistants and those who are announced as lecturers for the year only. Counting all, there are two hundred forty eight this year, a gain of fifteen over those published in last year's Catalogue. Without counting the Research Associates and Assistants or the lecturers, the number of members of the Instructing Staff to that of students bears the proportion of one to eleven and seven tenths.

The number of students registered for the current year has dropped from fifteen hundred and sixty one of last year to fourteen hundred and sixty six. In the fourth and second years there is a gain in the number of regular and special students; in the third and first years there is a loss in the number of regular students of both years and of special students of the first year, and a gain in the number of special students in the third year. Though the total number of regular students is less than last year, the total number of specials is greater.

The number of new students this year is four hundred seventy six, or thirty two per cent. of the school; last year there were five hundred seventy five, which was thirty seven per cent. Of the new students this year more than one third took their places in classes above the first year, while less than one third did so last year; the corresponding per cents of these students for the two years are thirty nine and thirty one, respectively.

The greatest change in the distribution of regular students above the first year and among the professional Courses is the decrease of twenty three in the Course in Mining Engineering and Metallurgy from a total of seventy seven last year. There is a similar change in the courses in Chemistry (forty six to thirty six), Sanitary Engineering (twenty two to thirteen), and

Naval Architecture (forty-nine to thirty-eight). There are no regular students in the Course in Geology and Geodesy or in the Course in General Science.

Ten more students have registered as regular five-year students this year than last.

The number of graduate students has risen from one hundred eighty-two to two hundred one, and the number of universities and colleges represented by these students is now thirty-three universities and fifty-two colleges as compared with thirty-seven universities and fifty colleges last year.

The registration in the Summer School (two hundred and sixty-six) was greater this year than in any previous year; the number of students (forty) from other colleges or schools was, however, smaller than last year. There was a decrease in the number of those who attended to make up failures or deficiencies, while there was a marked increase in those who were anticipating work. Courses were anticipated principally in Mechanic Arts, Descriptive Geometry, Architectural Design, Languages, Mechanical Drawing and Surveying; chiefly by former students.

While the registration this year is less than that of last year the number of states represented by the student body is two more than last year; one less territory is represented. The number from Massachusetts has fallen off from eight hundred and eighty-nine to eight hundred and seven, which reduces the Massachusetts students from fifty-seven to fifty-five per cent. of the student body. The drop in the number of students from Massachusetts is divided among the following counties: Barnstable (3), Bristol (4), Essex (24), Franklin (2), Hampshire (2), Middlesex (17), Suffolk (28), and Worcester (11). The number of foreign students has increased from sixty to sixty-six.

In the states that are represented there has been an increase of two or more students from California (5), Iowa (4), Kansas (3), Minnesota (4), Missouri (4), Pennsylvania (2), Rhode Island (6), Texas (3), Virginia (3), and Wyoming (2); and a decrease of two or more from the District of Columbia (4),

Georgia (2), Kentucky (3), Louisiana (4), Maine (4), Massachusetts (82), Montana (2), New Hampshire (4), New Jersey (5), New York (23), Oregon (3), Wisconsin (2), and from the Philippine Islands (2). By districts there has been a loss in only the North Atlantic and the South Central States.

The Faculty Committee on Undergraduate Scholarships, at its annual meeting for the awards for the current year, entertained two hundred sixty-six applications for aid. One hundred eighty-seven awards, amounting in all to $23,425, were made. Thirty-four of these awards were replaced wholly or in part by State aid, to total amount of $3,950. The number who made applications for State aid and did not ask for Institute aid was fifty-seven. This makes a total of three hundred twenty-three applications for Scholarship aid. The fifteen State awards to those who received no Institute assistance, added to the one hundred eighty-seven Institute awards, gives a total number of two hundred two students who are receiving scholarship assistance.

Last year at the request of the State Bureau of Statistics of Labor the occupations of the fathers of the students were asked for; this year the students were asked for similar information with the result shown in the following table. The tabulation which is given is based on the second term of last year and the first term of this year.

Occupations.	1904–05 Second Term		1905–06 First Term.	
	Number.	Per Cent.	Number.	Per Cent.
Business	637	44.9	583	39.8
Professional	165	11.6	197	13.4
Government Officials	49	3.5	43	2.9
Farmers	48	3.4	30	2.0
Wage Earners	153	10.8	258	17.6
Retired or Deceased	116	8.2	219	15.0
Not Given	250	17.6	136	9.3
Total	1,418	100.0	1,466	100.0

The usual tables of statistics for the current year are presented below.

WALTER HUMPHREYS, *Registrar.*

THE CORPS OF INSTRUCTORS.

The following table shows the distribution among the several classes of instructors, in comparison with last year:—

	1904–05.		1905–06.	
Professors	28		35	
Associate Professors	18		15	
Assistant Professors	20		24	
		66		74
Instructors	67		72	
Assistants	56		53	
		123		125
Research Associates	5		6	
Research Assistants	6		4	
		11		10
Lecturers	33	33	39	39
Total	233			248

STUDENTS AND GRADUATES.

The following table shows the registration of successive years from the foundation of the Institute:—

Year.	No. of Students.	Year.	No. of Students.
1865–66	72	1886–87	637
1866–67	137	1887–88	720
1867–68	167	1888–89	827
1868–69	172	1889–90	909
1869–70	206	1890–91	937
1870–71	224	1891–92	1,011
1871–72	261	1892–93	1,060
1872–73	348	1893–94	1,157
1873–74	276	1894–95	1,183
1874–75	248	1895–96	1,187
1875–76	255	1896–97	1,198
1876–77	215	1897–98	1,198
1877–78	194	1898–99	1,171
1878–79	188	1899–1900	1,178
1879–80	203	1900–1901	1,277
1880–81	253	1901–1902	1,415
1881–82	302	1902–1903	1,608
1882–83	368	1903–1904	1,528
1883–84	443	1904–1905	1,561
1884–85	579	1905–1906	1,466
1885–86	609		

STUDENTS BY CLASSES.

The aggregate number of students for 1905–06 is divided among the several classes, as follows:—

Fellows	13
Graduate students, candidates for advanced degrees	13
Regular students, Fourth Year	243
" " Third "	169
" " Second "	199
" " First "	215
Special students	614
Total	1,466

Assigning the special students to classes, according to the predominant studies pursued by them, we reach the following division of the whole body among the several years:—

Class.	Regular.	Special.	Total.
Fellows and Graduates of the M.I.T.	26	—	26
Fourth Year	243	138	381
Third Year	169	189	358
Second Year	199	210	409
First Year	215	77	292
Total	852	614	1,466

THE COURSES OF INSTRUCTION.

The following table presents the number of the regular students in the second, third, and fourth years, by Courses:—

Year.	Civil Engineering.	Mechanical Engineering.	Mining Engineering and Metallurgy.	Architecture.	Chemistry.	Electrical Engineering.	Biology.	Physics.	General Science.	Chemical Engineering.	Sanitary Engineering.	Geology.	Naval Architecture	Total.
4th Year Class	44	63	28	21	15	32	1	3	–	9	5	–	22	243
3d " "	44	35	11	13	11	28	–	4	–	8	5	–	10	169
2d " "	46	51	15	10	10	40	–	6	–	12	3	–	6	199
Total	134	149	54	44	36	100	1	13	–	29	13	–	38	611

The following table shows the figures of the total line in the foregoing table, in comparison with the corresponding figures for the next eleven preceding years:—

Year.	Civil Engineering.	Mechanical Engineering.	Mining Engineering and Metallurgy.	Architecture.	Chemistry.	Electrical Engineering.	Biology.	Physics.	General Course.	Chemical Engineering.	Sanitary Engineering.	Geology.	Naval Architecture.	Total.
1894	88	111	19	48	50	137	5	9	19	35	13	1	20	556
1895	88	118	25	67	59	126	7	11	14	25	10	3	22	575*
1896	99	117	24	65	66	106	7	11	11	34	8	–	25	573*
1897	109	119	38	71	60	90	8	9	10	36	7	1	26	578
1898	93	108	52	64	64	94	6	8	12	38	7	1	33	574
1899	99	113	60	53	58	84	8	7	11	30	14	1	38	575*
1900	89	127	69	53	50	87	6	4	8	34	17	1	38	582
1901	102	129	76	40	35	96	6	13	9	30	14	1	39	590
1902	129	133	83	43	58	118	2	20	9	30	12	1	65	703
1903	132	161	91	53	55	126	4	23	6	27	14	1	72	765
1904	140	158	77	41	46	98	4	13	—	32	22	1	49	681
1905	134	149	54	44	36	100	1	13	—	29	13	—	38	611

The following table shows, by classes and by Courses, the number of regular students who have registered themselves as electing to distribute the required studies and exercises over the period of five years:—

Year.	Total.	Course.												
		I.	II.	III.	IV.	V.	VI.	VII.	VIII.	IX.	X.	XI.	XII.	XIII.
1st . . .	2	–	–	–	–	–	–	–	–	–	–	–	–	–
2d . . .	10	6	1	1	–	–	–	–	–	–	2	–		–
3d . . .	13	3	5	2	1	1	1	–	–	–	–	–	–	–
4th . . .	17	4	6	1	–	–	1	1	–	–	2	–	–	2
5th . . .	2	–	2	–	–	–	–	–	–	–	–	–	–	–
	44	13	14	4	1	1	2	1	–	–	4	–	–	2

The following is the number of students, either regular or special, pursuing certain leading branches of study, in each of the four years:—

* Deducting those counted twice.

	First Year.	Second Year.	Third Year.	Fourth Year.	Total.
Mathematics	287	374	152	5	818
Chemistry	293	110	103	103	609
English	265	338	47	–	650
French	224	–	19	–	243
Physics	–	380	340	66	786
German	178	184	53	–	415
Mechanic Arts	–	136	71	94	301

SUMMER SCHOOL.

TABLE SHOWING THE NUMBER OF STUDENTS REGISTERED IN EACH OF THE COURSES OF THE SUMMER SCHOOL FOR THIS YEAR AND THE YEAR BEFORE.

	1904	1905
Air, Water and Food Analysis	5	0
Analytic Geometry	26	30
Applied Mechanics	21	24
Bacteriology	2	2
* Carpentry and Wood Turning	6	8
Chemistry, Inorganic and Analytical	42	42
Chipping and Filing	12	3
Descriptive Geometry	38	36
Design	3	6
Drawing Design	0	1
Forging	16	10
French	13	14
German	10	19
Integral Calculus	11	12
* Joinery and Pattern Work	1	6
Machine Drawing	0	4
Machine Tool Work	32	26
Mechanical Drawing	20	19
Mechanical Engineering Drawing	0	4
Mechanism and Valve Gears	13	6
Organic Analysis	2	0
Organic Preparation and Reactions	5	0
* Pattern Work	6	8
Physical Laboratory	8	15
Physics	44	43
Shades and Shadows	3	5
Surveying	7	27

* Wood work.

RESIDENCE OF STUDENTS.

States.	Candidates for Advanced Degrees.	Fourth Year.	Third Year.	Second Year.	First Year.	All Regular Students.	Special Students.	Total.
Alabama	–	–	–	1	–	1	–	1
Arkansas	–	–	–	–	1	1	–	1
California	–	3	1	1	3	8	15	23
Colorado	–	6	3	1	2	12	5	17
Connecticut	1	4	4	9	6	24	26	50
Delaware	–	–	–	–	1	1	–	1
Dist. of Columbia.	1	3	2	–	1	7	6	13
Florida	1	–	–	1	–	2	1	3
Georgia	–	–	–	–	1	1	7	8
Hawaii	–	–	–	–	–	–	1	1
Illinois	1	6	7	5	2	21	21	42
Indiana	2	1	–	2	2	7	3	10
Iowa	–	–	1	2	2	5	8	13
Kansas	–	1	1	2	–	4	3	7
Kentucky	–	–	1	1	–	2	3	5
Louisiana	–	–	–	–	–	–	1	1
Maine	–	6	3	1	1	11	11	22
Maryland	–	–	3	3	2	8	11	19
Massachusetts	14	143	93	133	146	529	278	807
Michigan	–	–	1	–	1	2	8	10
Minnesota	–	2	2	–	1	5	8	13
Mississippi	–	–	3	–	1	4	–	4
Missouri	–	6	1	2	4	13	16	29
Montana	–	–	–	–	–	–	3	3
Nebraska	1	–	–	1	–	2	2	4
Nevada	–	–	–	–	–	–	1	1
New Hampshire	1	5	3	4	3	16	16	32
New Jersey	–	4	1	4	–	9	2	11
New York	1	13	10	9	8	41	30	71
Ohio	2	6	5	–	2	15	19	34
Oregon	–	3	–	–	–	3	2	5
Pennsylvania	1	8	10	7	3	29	29	58
Philippine Islands,	–	–	–	–	–	–	2	2
Porto Rico	–	1	–	–	1	2	3	5
Rhode Island	–	2	2	3	5	12	12	24
South Carolina	–	–	–	–	–	–	1	1
Tennessee	–	–	–	–	–	–	2	2
Texas	–	4	3	1	2	10	6	16
Utah	–	–	–	–	–	–	2	2
Vermont	–	–	4	–	–	4	1	5
Virginia	–	3	1	–	–	4	3	
Washington	–	–	1	–	–	1	–	1
West Virginia	–	–	1	–	–	1	–	1
Wisconsin	–	6	1	1	2	10	2	12
Wyoming	–	–	–	–	–	–	2	2
Foreign Countries.								
Armenia	–	–	–	–	1	1	2	3
Australia	–	–	–	–	1	1	2	3
Bermuda	–	–	–	–	–	–	1	1
Brazil	–	1	–	–	–	1	–	1
Chile	–	–	–	–	2	2	–	2
China	–	–	–	–	–	–	8	8
Cuba	–	–	1	–	1	2	2	4
Denmark	–	–	–	1	–	1	–	1
England	–	1	–	1	1	3	2	5
Egypt	–	–	–	–	1	1	–	1
France	–	–	–	1	–	1	–	1
India	–	–	1	–	–	1	1	2
Ireland	–	1	–	–	–	1	1	2
Italy	–	–	2	–	–	2	–	2
Japan	–	–	–	–	1	1	2	3
Mexico	–	–	–	–	1	1	6	7
New Brunswick	–	–	–	–	–	–	4	4
Nova Scotia	–	–	–	–	1	1	–	1
Ontario	–	–	–	1	–	1	5	6
Peru	–	–	–	–	–	–	1	1
Quebec	–	–	–	–	–	–	1	1
Scotland	–	–	–	1	–	1	–	1
Transvaal	–	–	–	–	–	–	3	3
Turkey	–	–	1	–	–	1	–	1
Uruguay	–	–	–	–	2	2	–	2
Total	26	243	169	199	215	852	614	1,466

Forty-two states of the Union and one territory, besides the District of Columbia, Porto Rico and the Philippine Islands, are represented on our list of students. Of the total number of 1,466, 807 are from Massachusetts, or 55 per cent. of the whole; 133 are from other New England states; 526 are from outside New England. Of these 66 are from foreign countries.

A TABLE TO SHOW THE NUMBER OF STUDENTS IN EACH YEAR, FROM 1899, COMING FROM EACH STATE OR TERRITORY.

STATES AND TERRITORIES.	1899.	1900.	1901.	1902.	1903.	1904.	1905.
North Atlantic.							
Connecticut	29	35	42	43	44	48	50
Maine	25	22	30	35	34	26	22
Massachusetts	731	779	837	935	869	889	807
New Hampshire	29	26	31	34	23	36	32
New Jersey	12	8	6	8	13	16	11
New York	61	68	79	96	104	94	71
Pennsylvania	33	37	36	44	52	56	58
Rhode Island	32	35	38	40	28	19	24
Vermont	12	15	15	12	11	5	5
Total	964	1,025	1,114	1,247	1,178	1,189	1,080
South Atlantic.							
Delaware	4	4	3	4	3	2	1
Dist. of Columbia	7	13	14	17	15	17	13
Florida	1	1	1	2	2	4	3
Georgia	3	3	4	6	4	6	8
Maryland	8	13	16	27	25	18	19
North Carolina	2	2	6	6	7	1	–
South Carolina	1	1	2	4	–	–	1
Virginia	2	3	5	7	7	4	7
West Virginia	1	1	1	–	–	–	1
Total	29	41	52	73	63	52	53
South Central.							
Alabama	–	1	2	1	1	1	1
Arkansas	–	1	1	1	1	–	1
Kentucky	4	5	9	11	9	8	5
Louisiana	1	2	1	2	2	5	1
Mississippi	–	–	–	–	4	4	4
Tennessee	4	6	4	3	5	2	2
Texas	2	4	7	9	11	13	16
Total	11	19	24	27	33	33	30
North Central.							
Illinois	36	39	44	49	44	43	42
Indiana	5	7	11	14	6	10	10
Iowa	6	10	8	8	6	9	13
Kansas	–	–	1	1	1	4	7
Michigan	10	8	12	10	9	9	10
Minnesota	10	7	10	10	9	11	13
Missouri	11	13	19	20	22	25	29
Nebraska	3	4	3	5	4	5	4
North Dakota	–	–	–	1	1	1	–
Ohio	27	27	27	43	37	35	34
South Dakota	1	1	2	1	3	2	–
Wisconsin	7	8	11	11	13	14	12
Total	116	124	148	173	155	168	174
Western.							
California	9	10	9	15	19	18	23
Colorado	7	8	6	10	11	16	17
Idaho	–	–	1	–	–	–	–
Montana	3	5	4	3	2	5	3
Nevada	1	1	–	–	–	–	1
New Mexico	–	–	–	1	1	2	–
Oregon	2	1	2	4	7	8	5
Utah	6	7	7	2	3	3	2
Washington	4	2	4	3	3	2	2
Wyoming	–	–	–	1	–	–	2
Hawaii	–	1	–	–	1	1	1
Philippine Islands	–	–	–	–	–	4	2
Porto Rico	–	–	1	2	2	4	5
Total for the United States	1,152	1,244	1,372	1,561	1,478	1,505	1,400

A TABLE TO SHOW THE NUMBER OF STUDENTS IN EACH YEAR, FROM 1899, COMING FROM EACH FOREIGN COUNTRY.

FOREIGN COUNTRIES.	1899.	1900.	1901.	1902.	1903.	1904.	1905.
Armenia	–	–	–	–	1	1	3
Australia	–	–	–	2	3	1	3
Austria	–	–	1	–	–	–	–
Bermuda	–	1	2	1	1	–	1
Brazil	–	–	4	5	3	3	1
Central America	–	–	–	–	–	1	–
Chili	–	–	1	1	1	1	2
China	–	–	1	1	2	8	8
Cuba	–	–	1	2	3	4	4
Denmark	1	1	1	1	1	1	1
Dutch Guiana	1	–	–	–	–	–	–
Ecuador	–	–	–	–	–	1	–
Egypt	–	–	–	–	–	–	1
England	1	3	3	3	4	4	5
France	2	4	1	–	–	1	1
Germany	1	2	3	1	2	–	–
India	–	–	–	–	1	1	2
Ireland	–	–	–	1	1	–	2
Italy	–	–	–	–	–	–	2
Jamaica	1	1	1	–	–	1	–
Japan	2	2	2	1	2	1	3
Korea	–	–	–	–	–	2	–
Malta, Island of	–	–	–	–	1	1	–
Manitoba	–	–	–	1	1	–	–
Mexico	7	7	7	10	8	4	7
New Brunswick	3	2	2	2	1	2	4
Nova Scotia	–	2	6	8	9	4	1
Ontario	–	–	3	2	2	5	6
Peru	–	–	–	–	–	–	1
Quebec	3	4	2	–	1	2	1
Russia	1	1	1	–	–	–	–
Scotland	–	–	–	1	1	2	1
Sweden	–	–	–	–	–	1	–
Syria	–	–	–	–	1	1	–
Transvaal	–	–	–	–	–	1	3
Turkey	3	3	1	4	–	2	1
Uruguay	–	–	–	–	–	–	2
Total	26	33	43	47	50	56	66
Total in school	1,178	1,277	1,415	1,608	1,528	1,561	1,466

RESIDENCE OF MASSACHUSETTS STUDENTS.

It has been said that 55 per cent. of our students are from Massachusetts. All the counties of the State except Nantucket send students to the Institute. One hundred forty-five cities and towns are on the lists. The first column of the following table shows the number of cities and towns in each county sending pupils: the second column gives the aggregate number from each county. It appears that Middlesex sends two hundred

fifty-seven and Suffolk two hundred twenty-seven pupils; Essex comes third, with one hundred four; Norfolk, fourth, with eighty-five.

County.	No. of Towns.	No. of Students.	County.	No. of Towns.	No. of Students.
Barnstable	3	3	Hampshire	1	3
Berkshire	8	16	Middlesex	33	257
Bristol	12	34	Norfolk	26	85
Dukes	1	2	Plymouth	15	28
Essex	24	104	Suffolk	4	227
Franklin	4	4	Worcester	10	24
Hampden	4	20			
			Total	145	807

The following is the list of the towns, thirty-five in number, which send five or more students to the Institute:—

Boston	210	Framingham	11	Milford	7
Newton	52	Medford	10	Milton	7
Cambridge	29	Salem	10	New Bedford	7
Brookline	22	Wakefield	10	Wellesley	7
Somerville	22	Hyde Park	9	Beverly	6
Waltham	19	Lynn	9	Pittsfield	6
Malden	18	Chelsea	8	Abington	5
Lowell	15	Melrose	8	Arlington	5
Haverhill	13	Quincy	8	Brockton	5
Newburyport	13	Springfield	8	Dedham	5
Lawrence	12	Belmont	7	Revere	5
Taunton	12	Gloucester	7		

The following table exhibits for ten years the distribution of the total number of students among two classes: first, those students whose names are found upon the Catalogue of the year preceding; and, secondly, those whose names appear first upon the Catalogue of the year to which the statement relates.

Year.	(1) Total No. of Students.	(2) No. of Students in the catalogue of the previous year who remain in the Institute.	(3) No. of New Students entering before issue of catalogue.	(4) Of those in column (3) the following number are regular First-year Students.	(5) No. of New Students not of the regular First-year Class.
1896–97	1,198	758	440	263	177
1897–98	1,198	757	441	277	164
1898–99	1,171	769	402	278	124
1899–1900	1,178	764	414	275	139
1900–1901	1,277	789	488	312	176
1901–1902	1,415	844	571	396	175
1902–1903	1,608	949	659	432	226
1903–1904	1,528	1,042	486	249	237
1904–1905	1,561	986	575	295	280
1905–1906	1,466	984	482	213	269

AGES OF STUDENTS.

The next table exhibits the ages of our students upon entrance, after taking out two who are repeating the first year, and eleven persons of unusual ages. These deductions leave two hundred two as the number of students whose ages have been made the subject of computation.

Period of Life.	1904–1905.		1905–1906.	
	Half-year Groups.	Yearly Groups.	Half-year Groups.	Yearly Groups.
16 to 16½ years	1	—	1	—
16½ to 17 "	8	9	4	5
17 to 17½ "	22	—	13	—
17½ to 18 "	40	62	28	41
18 to 18½ "	47	—	42	—
18½ to 19 "	51	98	34	76
19 to 19½ "	41	—	30	—
19½ to 20 "	40	81	23	53
20 to 20½ "	15	—	14	—
20½ to 21 "	10	25	6	20
21 to 22 "	9	9	7	7
	284	284	202	202

The results appear in the table above in comparison with the corresponding results of 1904–05.

From the foregoing it appears that the average age on entrance is eighteen years and eight months.

In this connection are presented the ages, at graduation, of the class which left us in June. The two hundred forty-four members of the class were distributed among the different periods of life as follows:—

Under 20½	3
Between 20½ and 21	12
" 21 " 21½	23
" 21½ " 22	30
" 22 " 23	63
" 23 " 24	53
24 and over	60
Total	244

The average age was twenty-three years and three months.

The special students this year constitute forty-two per cent. of the whole body, as against thirty-five per cent. last year and thirty-two per cent. the year before.

GRADUATE STUDENTS.

The number of students who are graduates of this and other institutions is two hundred one. Of these twenty-six are candidates for advanced degrees, sixteen being our own graduates.

One hundred seventy-five are graduates of the following institutions, and are pursuing undergraduate courses of study with us either as regular or as special students.

Universities.

Boston	2	Northwestern	1
Brown	5	Ohio State	2
California	2	Ohio Wesleyan	1
Chicago	1	Pennsylvania	2
Cornell	1	Princeton	12
De Pauw	1	Rochester	1
Ferrara (Italy)	1	Saint Louis	3
Georgia	1	Southwestern	1
Georgetown	2	Spanish	1
Harvard	18	Texas	3
Illinois	1	Tientsin (China)	1
Indiana	1	Vermont	2
Johns Hopkins	5	Washington and Lee	1
Maine	1	Wesleyan	2
Mercer	1	Wisconsin	3
Michigan	1	Yale	10
Montevideo (Uruguay)	2		92

Colleges.

Acadia	1	New Hampshire Agricultural	1
Amherst	1	Oregon Agricultural	1
Anatolian	1	Pennsylvania Military	2
Bates	5	Radcliffe	1
Beloit	5	Randolph-Macon	1
Boston	3	Rock Hill	1
Bowdoin	1	Rose Polytechnic Institute	1
Bradley Polytechnic Institute	1	Royal College of Science for Ireland	1
Case School of Applied Science	2	Saint Mary's Institute	1
Centenary of Louisiana	1	Saint Vincent	1
Central Technical, London	1	Saint Francis Xavier	1
Centre	1	Texas Agricultural and Mechanical	3
Colby	2	Throop Polytechnic Institute	2
Dartmouth	5	U.S. Military Academy	1
Earlham	1	U.S. Naval Academy	17
Fordham	1	Virginia Military Institute	2
Franklin and Marshall	1	Wabash	1
Geneva	1	Washington and Jefferson	2
Hamilton	1	Wellesley	1
Iowa	1	William and Mary	1
Iowa State	1	Williams	5
Kansas	1	Wittenberg	1
Kansas State Agricultural	2		113
Kentucky State	1		
Lafayette	1		
Maryland Agricultural	1		
Massachusetts Institute of Technology	19	Total	205
Middlebury	1	Deduct names counted twice	4
Milton	3		201
Missouri School of Mines	1		

WOMEN STUDENTS.

The number of women pursuing courses with us is twenty-seven. Of these four are graduates of colleges. Of the total number four are regular students of the fourth year, one of the third, and five of the first year. One is working for an advanced degree. Sixteen are special students. Of the five regular students of the upper classes two take Course IV., Architecture; and three, Course V., Chemistry. Of the special students, four devote themselves to Architecture, nine to Biology, one to Geology, and one to Mechanical Engineering, while one is a first-year student.

STATISTICS OF ADMISSION.

Of the 1,466 students of the present year, 476 were not connected with the school in 1904–05. Of these 190 were admitted as regular students of the first year upon the basis of their entrance examinations. The 286 remaining comprise (1) those who had previously been connected with the Institute, and have resumed their places in the school; (2) those

who were admitted provisionally without examinations; (3) those who were admitted by examination as regular second-year or as special students; (4) those who were admitted on the presentation of diplomas or certificates from other institutions of college grade. In addition to the 190 who were thus admitted to the first year on examination, and have taken their place in the school, 57 were admitted on examination, but have not entered the school.

In the case of the 222 persons who were admitted on examination, and have joined the school as regular students or as special students, the results of the examinations, embracing both those of June and those of September, were as follows:—

	Regulars.	*Specials.*
Admitted clear	130	7
" on one condition	47	15
" on two conditions	10	8
" on three conditions	3	2
	190	32

Of the 698 persons who presented themselves in June for examination, 25 Complete, 39 Final, 108 Preliminary, and 28 Partial candidates, a total of 200, were rejected. In September 32 Complete, 19 Final, and 11 Preliminary candidates were rejected. 246 candidates including those for advanced standing attended the September examinations.

GRADUATES BY COURSES.

Year.	Civil Engineering.	Mechanical Engineering.	Mining Engineering.	Architecture.	Chemistry.	Metallurgy.	Electrical Engineering.	Natural History or Biology.	Physics.	General Course.	Chemical Engineering.	Sanitary Engineering.	Geology.	Naval Architecture.	Total.
1868	6	1	6	–	–	–	–	–	–	1	–	–	–	–	14
1869	2	2	–	–	1	–	–	–	–	–	–	–	–	–	5
1870	4	2	2	–	1	–	–	–	–	1	–	–	–	–	10
1871	8	2	5	–	2	–	–	–	–	–	–	–	–	–	17
1872	3	1	5	–	3	–	–	–	–	–	–	–	–	–	12
1873	12	2	3	1	7	–	–	–	–	1	–	–	–	–	26
1874	10	4	1	1	–	–	–	–	–	2	–	–	–	–	18
1875	10	7	6	1	1	–	–	–	1	2	–	–	–	–	28
1876	12	8	7	–	5	1	–	2	3	4	–	–	–	–	42
1877	12	6	8	4	2	–	–	–	–	–	–	–	–	–	32
1878	8	2	2	3	3	–	–	–	–	1	–	–	–	–	19
1879	6	8	3	1	3	–	–	1	1	–	–	–	–	–	23
1880	3	–	3	–	1	–	–	–	–	1	–	–	–	–	8
1881	3	5	6	3	8	–	–	1	–	2	–	–	–	–	28
1882	2	5	5	3	6	–	–	1	1	1	–	–	–	–	24
1883	3	7	5	1	3	–	–	–	–	–	–	–	–	–	19
1884	5	6	13	–	12	–	–	–	–	–	–	–	–	–	36
1885	4	7	8	2	4	–	2	–	–	1	–	–	–	–	28
1886	9	23	7	1	7	–	10	1	–	1	–	–	–	–	59
1887	10	17	8	1	9	–	8	1	1	3	–	–	–	–	58
1888	11	25	4	5	10	–	17	3	1	1	–	–	–	–	77
1889	14	24	5	3	8	–	17	1	1	2	–	–	–	–	75
1890	25	28	3	5	13	–	18	3	2	6	–	–	–	–	103
1891	18	26	4	6	11	–	23	3	3	1	7	–	1	–	103
1892	22	26	4	13	7	–	36	6	1	7	4	6	1	–	133
1893	25	30	5	2	8	–	41	2	–	6	8	–	2	–	129
1894	21	31	4	14	11	–	33	1	3	5	12	3	–	–	138
1895	25	30	3	15	14	–	33	–	2	4	11	4	–	5	144*
1896	26	34	10	24	17	–	48	3	3	7	7	4	3	5	190*
1897	25	40	7	16	20	–	33	2	3	7	12	4	1	9	179
1898	32	41	7	29	25	–	33	3	4	6	9	3	–	7	199
1899	30	37	9	22	22	–	32	2	2	1	10	1	–	8	173*
1900	32	34	21	21	19	–	23	3	3	5	11	4	–	9	185
1901	37	39	18	21	17	–	25	1	1	6	14	4	1	16	200
1902	24	46	14	18	14	–	35	5	3	3	9	7	–	14	192
1903	26	37	27	15	13	–	39	1	4	1	10	4	1	12	190
1904	34	45	32	24	15	–	34	3	13	5	7	2	1	17	232
1905	46	54	26	12	23	–	31	3	3	3	13	5	1	24	244
Totals	605	742	306	287	345	1	571	52	59	96*	144	51	12	126	3,392*

Names counted twice, students graduating in two different years	16
Bachelors of Science	3,376*
Masters of Science, not included in the above	14
Total	3,390*

* Deducting names counted twice (students graduating in two courses).

The Society of Arts.

To the President of the Massachusetts Institute of Technology:

Sir,—On behalf of the Executive Committee I have the honor to present the annual report of the Society of Arts for the year ending May 11th, 1905.

During the past year the Society of Arts has held meetings as provided by the by-laws, the first having been on October 13, 1904. These meetings have been well attended, thus providing evidence of the position of the Society as a factor in the dissemination of scientific information to the public. The average attendance was one hundred and twenty-five.

The following papers have been read:—

Geology as an Experimental Science, by Professor Thomas A. Jaggar, Jr.

A Practical Color System Based upon Photometric Measurements, by Mr. Albert H. Munsell.

Sanitary Plumbing and our Plumbing Laws, with Suggestions for their Revision and Simplification, by Mr. J. Pickering Putnam.

On Manila and the Philippines as they are To-day, by Mr. Desmond Fitzgerald, C.E.

Mont Pelée and the Eruptions of 1902; the Growth of the Wonderful Spine, by Mr. Edmund Otis Hovey.

The Evolution and Improvement of Domestic Plants, by Dr. H. J. Webber.

The Orientation of Buildings; or the Planning of Buildings and Streets with Regard to Light, by Mr. William Atkinson.

The Hookworm Disease: a New and Important Parasitic Disease of Man, by Dr. Charles Wardell Stiles.

Purification of Public Water Supplies in the Middle West, by Erastus G. Smith, Ph.D.

Wireless Telegraphy, by Mr. John Stone Stone.

The Abolition of Grade Crossings in Chicago by Track Elevation, by Mr. Charles B. Breed.

The Physiography and Geography of Hawaii, by Professor George H. Barton.

Storage Batteries, by Mr. Philip W. Davis.

The Work of the Massachusetts Railroad Commission, by Mr. James F. Jackson.

Of the foregoing several were of special scientific importance, and awakened much interest, notably those by Messrs. Munsell, Putnam, Webber, Stiles, and Smith; and the papers by the two first-named gentlemen have appeared in an expanded form in the *Technology Quarterly*.

The membership in the Society has remained practically constant, numbering three hundred and sixty-two.

The *Technology Quarterly*, under the editorship of Dr. Bigelow, has appeared at the regular intervals, and has contained the usual abstract of the Proceedings of the Society of Arts, together with such of the papers read before the Society as had been prepared in manuscript.

Various Departments of the Institute have contributed a number of important papers. Professor W. O. Crosby and Mr. G. F. Loughlin have begun a "Descriptive Catalogue of the Building Stones of Boston and Vicinity," considered in their geological and economical relations, with references to buildings in which they have been used. Professor Noyes has contributed a second part to his "System of Qualitative Analysis," and his address read before the International Congress of Arts and Sciences on the "Physical Properties of Aqueous Salt Solutions in Relation to the Ionic Theory." Other contributions from the Chemical Department have been an article by Professor Gill and Mr. Foster on "White Lead and its Protecting Properties," one by Professor W. H. Walker and Mr. Bourne on the "Hydrolytic Enzyme Contained in Castor-oil Seeds," and four contributions from the Laboratory of Sanitary Chemistry. From the Sewage Experiment Station, Mr. Phelps has contributed a paper on the "Interpretation of a Sewage Analysis," and Mr. S. DeM. Gage, of the Experiment Station in Lawrence, has published the results of his studies

on the "Bacteriolysis of Peptones and Nitrates." The activity of the Mining Department is shown by three valuable papers by Professor Hofman and his students.

The book reviews have become a permanent and valuable feature of the *Quarterly*. During the year fifteen books have been reviewed, chiefly by members of the Institute.

At the forty-third annual meeting, held on May 11, 1905, the following-named gentlemen were elected officers of the Society for the year 1905–06:—

Executive Committee.—George W. Blodgett, Edmund H. Hewins, Charles T. Main, James P. Munroe, and A. Lawrence Rotch.

Secretary.—Samuel C. Prescott.

Board of Publication.—W. T. Sedgwick, Dwight Porter, H. E. Clifford, and R. P. Bigelow.

Respectfully submitted,

SAMUEL C. PRESCOTT, *Secretary*.

Publications.

MECHANICAL ENGINEERING.

G. LANZA—Applied Mechanics. New and revised edition.

G. LANZA—Memoir of Professor L. Tetmajer. *Proceedings of the American Society for Testing Materials.* 1905.

G. LANZA—Report of Committee on Standard Methods of Tests. *Proceedings of the American Society for Testing Materials.* 1905.

E. F. MILLER—Practical Instructions in the Use and Care of the Crosby Steam Engine Indicator. E. F. Miller, editor.

S. H. WOODBRIDGE—Report of Congress on Central Plant for Executive Building.

MINING ENGINEERING AND METALLURGY.

R. H. RICHARDS—Progress in Gold Mining during 1904. *The Mineral Industry.* Vol. XIII.

R. H. RICHARDS—Review of the Literature on Ore-dressing in 1904. *The Mineral Industry.* Vol. XIII.

R. H. RICHARDS—Notes on Mining, third-year, second Term. Published by the Institute.

H. O. HOFMAN—Recent Improvements in Lead Smelting during 1904. *The Mineral Industry.* Vol. XIII.

H. O. HOFMAN—Die Darstellung des Zinks auf Electrolytischen Wege. Review. *American Chemical Journal.* Vol. XXXIII., p. 608. 1905.

C. E. LOCKE—The Copper Mines of Lake Superior. Rickard. Review. *Technology Quarterly.* Vol. XVII., p. 318. 1905.

CHEMISTRY AND CHEMICAL ENGINEERING.

H. P. TALBOT.—Thomas Messinger Drown, LL.D. *Technology Review*, 1905.

H. P. TALBOT (with A. A. BLANCHARD).—The Electrolytic Dissociation Theory and Some of its Applications. New York, Macmillan Co., 1905.

A. A. NOYES.—The Ideals of the Institute. *The Technology Review*, Vol. VII., pp. 150–9.

W. H. WALKER.—Some Present Problems in Technical Chemistry. *Popular Science Monthly*, March, 1905; *Electrochemical Industry*, Vol. III., p. 27.

W. H. WALKER.—What Constitutes a Chemical Engineer. *The Chemical Engineer*, Vol. II., p. 10.

W. H. WALKER.—The Fixation of Atmospheric Nitrogen. *Report of the New England Association of Chemistry Teachers*, 1905.

W. H. WALKER.—The Influence of Phenols and Equivalent Bodies upon the Properties of Cellulose Acetate. United States Patent, No. 774,713–4. *Official Gazette*, Vol. CXIII., pp. 515–6.

W. H. WALKER (with E. C. SMITH and E. W. WIGGINS).—The Products of the Distillation of Pine Wood. *Technology Quarterly*, Vol. XVIII., p. 301.

W. H. WALKER (with H. S. MORK and A. D. LITTLE).—Process for the Manufacture of Artificial Silk. United States Patent, No. 792,149. *Official Gazette*, Vol. CXVI., p. 1805.

HENRY FAY (with F. W. SNOW)—Some Experiments on the Fuel Value of Bituminous Coal Ashes. *Journal of the American Chemical Society*, Vol. XXVII., p. 609.

A. H. GILL.—Engine Room Chemistry. *Power*, New York, May–November, 1905.

A. H. GILL.—A Short Handbook of Oil Analysis. Fourth edition. Philadelphia and London, J. B. Lippincott Co., 1905.

F. H. THORP.—Outlines of Industrial Chemistry. Second

edition, revised and enlarged. New York, Macmillan Co., 1905.

ELLEN H. RICHARDS.—First Lessons in Food and Diet. Boston, Whitcomb & Barrows, 1905.

ELLEN H. RICHARDS.—The Art of Right Living. Boston, Whitcomb & Barrows.

ELLEN H. RICHARDS.—The Cost of Shelter. New York, Wiley & Sons.

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GENERAL STATEMENT

OF THE

RECEIPTS AND DISBURSEMENTS BY THE TREASURER

FOR THE YEAR ENDING SEPT. 30, 1905

STATEMENT OF THE TREASURER.

The Treasurer submits the annual statement of the financial affairs of the Institute for the year ending September 30, 1905.

The most striking feature in this year's report is the large reduction in the deficit. This has been brought about mainly by the following changes:—

There has been an increase in students' fees of about $23,000, and at the same time a reduction in other items, in round numbers, as follows: in repairs, $2,000; insurance, $2,400; fuel, $2,500; electricity, $600; department supplies, $21,000; and in the St. Louis Exposition account, about $3,000.

To offset this, the salary account increased over $6,000, and there were additions to some other items making the net result a deficit, in the current expense account for the year, of $10,582.32, instead of $55,405.66 for last year; a decrease of $44,823.34.

The increase in students' fees was due mainly to the fact that the increased rate of tuition applied to one more class than the year before.

There have been certain losses and expenditures which do not enter into the current expense account. The Gymnasium has long stood on land which belonged to the Boston & Albany Railroad corporation. The terms granted to the Institute in this matter were generous, and have been allowed to continue for a long period, but the railroad corporation has now found it necessary to use this land, and as a result it was found best to sell the old gymnasium, although this involved a loss of nearly $7,000, and to erect on our Garrison Street land a new gymnasium for which thus far there have been payments amounting to about $4,000.

The following legacies and gifts have been received:—

From the estate of Mrs. Edna Dow Cheney, $13,741.66 as a fund for the benefit of the Margaret Cheney Reading Room. With this legacy came a portrait of Miss Margaret S. Cheney. Those who knew Miss Cheney testify to the excellence of the likeness, and it is most appropriate that this work of art should adorn the room which is itself a memorial to her. For the Sanitary Research Laboratory Fund, $5,000 from the same anonymous friend who has made the previous payments for this purpose. From the estate of the late George B. Upton, $5,000. From Lucius Clapp, Esq., for scholarship purposes, stock valued at $4,900. From the estate of Susan E. Dorr, in addition to previous amounts, $1,790.07. From Charles G. Weld, M.D., for

the Department of Naval Architecture, $1,545.32. For the Physico-Chemical Research Fund, the trustees of the Ellis Fund gave $1,000, and Samuel Cabot, Esq., $200. Mr. Cabot also gave $1,000 to constitute the Cabot Physical Fund. $1,000 were given by William W. Jacques, Ph.D., for the Physical Department, and $500 by an anonymous friend for salaries. From Mrs. Henry Pickering $550 were received for the Department of Zoology, and Mrs. William B. Rogers contributed $106.50 for the purchase of periodicals, the branch of the library for which she has done so much in the past.

Additional subscriptions to the Walker Memorial Fund have been paid, amounting to $5,000, and the whole fund, including accumulated income, is now $103,545.06.

Securities Sold or Paid, General Fund.

$50,000 Ch. Terminal & Transfer Co. 4s	1947	$48,500.00
5,000 American Tel. & Tel. Co. 5s	1907	5,100.45
3,000 Ozark Equipment Co. 5s	1910	3,000.00
5,000 Dominion Coal Co. 1st 6s	1943	5,000.00
64 Rights Boston Real Estate Trust		304.00
		$61,404.45

Securities Bought or Received as Legacies, General Fund.

50,000 Oregon Short Line R.R. 4s.	1929	$48,500.00
5,000 Terminal Asso. St. Louis 4s	1953	5,014.50
3,000 Lake Shore & Mich. Southern 4s	1928	3,000.00
5,000 American Tel. & Tel. Co. 4s	1929	4,625.00
50 Shares Union Pacific R.R. Pref.		4,000.00
		$60,237.50

GEORGE WIGGLESWORTH, TREASURER, *in account with*
GENERAL STATEMENT OF RECEIPTS AND DISBURSEMENTS

Dr.

Cash balance, Sept. 30, 1904		16,353.09
RECEIPTS FOR CURRENT EXPENSES.		
Income of funds for salaries	4,324.00	
" " " " Fellowships	2,100.00	
" " " " scholarships (students' fees)	9,950.00	
" " " " Joy "	162.50	
" " " " W. B. Rogers Scholarships	425.00	
" " " " Library	480.00	
" " " " general purposes	25,975.19	
" " Rogers Memorial Fund	10,815.00	
" " Charlotte B. Richardson Fund	1,495.15	
" " Rotch Prize Funds	400.00	
" " Rotch Architectural Fund	1,000.00	
" " Edward Austin Fund, Scholarships	7,412.50	
" " " " " Awards	5,910.15	
" " Teachers' Fund	5,700.00	
" " Ednah Dow Cheney Fund	49.97	
Letter Box Fund	75.00	
Students' fees	320,585.55	
State Scholarships	4,000.00	
United States Act of 1862	4,191.96	
United States Act of 1890	8,333.34	
Gift of State of Massachusetts	25,000.00	
Laboratory supplies and breakages	12,877.43	
Rents, per Table (page 12)	10,606.50	
Gifts	3,251.81	
Interest	2,599.59	
Boston University	94.50	
Sale Printed Lecture Notes	4,032.15	471,847.29
GIFTS AND BEQUESTS FOR SPECIAL PURPOSES.		
Increase Scholarship Funds	824.14	
" Edward Austin Fund	1,077.35	
" Susan E. Dorr Fund, additional	1,790.07	
" Lucius Clapp Fund	4,900.00	
" Ednah Dow Cheney Fund	13,741.66	22,333.22
GIFTS AND BEQUESTS FOR GENERAL PURPOSES.		
George B. Upton Legacy		5,000.00
SECURITIES SOLD OR PAID.		
General Fund, page 3		62,410.25
SUNDRIES.		
Income credited to Bond Premium Acc't	4,190.50	
" " " Rogers Bond Premium Acc't	668.00	
Copley Society of Boston, on acc't	666.66	
Walker Memorial Fund	9,385.24	
Cabot Medal Fund	1,000.00	
Sale of Old Gymnasium	1,000.00	
Sanitary Research Laboratory Fund, additional	5,000.00	
Physico-Chem. Research Fund	1,200.00	
Students' Notes	67.75	
Acc'ts Payable and Fees paid in advance	6,029.50	29,207.65
		$607,151.50

MASSACHUSETTS INSTITUTE OF TECHNOLOGY.

FOR THE YEAR ENDING SEPT. 30, 1905.

Cr.

EXPENSES.

Salaries, per Table (page 12)	346,689.88	
Fellowship paid from Savage Fund	750.00	
" " " Dalton Grad. Chem. Fund,	750.00	
" " " Swett Fund	400.00	
" " " H. Saltonstall Fund	200.00	
Edward Austin Fund, Awards	5,910.15	
Teachers' Fund "	5,700.00	
Prizes, Rotch Funds	400.00	
Repairs, per Table (page 13)	9,973.39	
General Expenses, per Table (page 13)	17,439.36	
Fire Insurance	2,413.65	
Fuel	16,451.69	
Water	3,279.83	
Gas	2,637.23	
Electricity	1,383.84	
Printing and Advertising	7,826.56	
" Lecture Notes	6,416.61	
" Annual Catalogues and Reports	4,169.49	
Physico-Chemical Research Fund	3,000.00	
Department Supplies, per Table (p. 12)	45,039.59	
Society of Arts	1,235.20	
St. Louis Exposition	313.17	
Margaret Cheney Reading Room	49.97	482,429.61

(Expenses more than Income, $10,582.32)

SECURITIES BOUGHT OR RECEIVED AS LEGACIES.

General Fund, page 3		66,237.50

SUNDRIES.

Cabot Medal Fund	793.75	
Equipment Electrical Engineering Building	732.09	
Sanitary Research Laboratory Fund	6,126.86	
Physico-Chem. Research Fund	4,720.53	
Dormitory Fund	875.00	
Walker Memorial Fund	16,367.50	
New Gymnasium	3,953.26	
Teachers' Fund used	1,700.00	35,268.99
Cash balance Sept. 30, 1905, less October coupons,		23,215.40
		$607,151.50

E. and O. E.

GEORGE WIGGLESWORTH,
Treasurer.

The following account exhibits the property held by the Institute, as per Treasurer's books, Sept. 30, 1905:—

INVESTMENT OF THE W. B. ROGERS MEMORIAL FUND.

31,000.00	N.Y. Central & H. R. R.R. Deb. 4s,	1934	30,225.00	
6,000.00	Baltimore & Ohio R.R. 3½s . . .	1925	5,310.00	
27,000.00	Kansas City Belt R.R. 6s	1916	27,000.00	
3,800.00	Republican Valley R.R. 6s	1919	3,800.00	
4,000.00	Cin., Ind., St. Louis & Chicago R.R. 6s	1920	4,000.00	
4,000.00	Kansas City, Fort Scott & Gulf R.R. 7s	1908	4,000.00	
1,000.00	Lincoln & Northwestern R.R. 7s . .	1910	1,000.00	
1,000.00	Atchison & Nebraska R.R. 7s . .	1908	1,000.00	
35,000.00	Fort Street Union Depot 4½s	1941	34,825.00	
24,000.00	Rome, Watertown & Ogdensburg R.R. 5s	1922	24,000.00	
37,500.00	Detroit, G. Rapids & Western R.R. 4s,	1946	37,500.00	
25,000.00	Atchison, Top. & St. Fé R.R. 4s . .	1995	24,470.00	
7,000.00	Chesapeake & Ohio R.R. 5s . . .	1939	7,000.00	
38,000.00	Chi. Junc. & Union Stock Yards 5s	1915	38,000.00	
	Advances to Bond Premium acc't .		6,743.00	
				248,873.00

INVESTMENTS, GENERAL ACCOUNT.

6,000.00	Bur. & Mo. River (Neb.) R.R. 6s, non-exempt	1918	6,000.00	
2,000.00	Bur. & Mo. River (Neb.) R.R. 6s, exempt	1918	2,000.00	
5,000.00	Chicago, Burlington & Quincy R.R. 4s	1922	4,100.00	
3,000.00	Hannibal & St. Joseph R.R. 6s . .	1911	3,000.00	
65,000.00	Boston & Maine R.R. 4½s	1944	65,000.00	
26,000.00	Am. Dock & Improvement Co. 5s .	1921	26,000.00	
3,000.00	Illinois Central R.R. 4s	1951	3,000.00	
8,000.00	Chi. Junc. & Union S. Yards 5s . .	1915	8,000.00	
2,000.00	New England Tel. & Tel. Co. 6s . .	1907	2,000.00	
100,000.00	West End Street Ry. 4s	1917	100,000.00	
50,000.00	Utah & Northern R.R. 1st 7s . . .	1908	50,000.00	
120,000.00	Illinois Steel Co., non-conv. 5s . .	1913	119,586.25	
43,000.00	Chesapeake & Ohio R.R. 5s . . .	1939	43,000.00	
100,000.00	Long Island R.R. 4s	1949	96,137.50	
7,000.00	K. C., Clinton & Springfield R.R. 5s,	1925	6,289.21	
8,500.00	K. C., Mem. & Birmingham R.R. 4s,	1934	8,287.50	
13,000.00	K. C., St. Jo. & Council Bluffs R.R. 7s	1907	13,000.00	
50,000.00	Kansas City Stock Yards 5s	1910	50,000.00	
25,000.00	Atchison, Top. & St. Fé R.R. 4s. .	1995	25,000.00	
50,000.00	Rio Grande & Western R.R. 4s . .	1939	49,180.00	
50,000.00	Oregon R.R. & Navigation Co. 4s,	1946	50,000.00	
50,000.00	Union Pacific R.R. 4s	1947	50,000.00	
100,000.00	Chic. & W. Michigan R.R. 5s . .	1921	100,000.00	
105,000.00	American Tel. & Tel. Co. 4s . . .	1929	104,700.00	
50,000.00	New England Tel. & Tel. Co. 4s .	1930	50,000.00	
50,000.00	Chi. Junc. & Union S. Yards 4s . .	1940	49,250.00	
50,000.00	K. C., Fort Scott & Memphis R.R. 6s	1928	50,000.00	
25,000.00	Southern Ry., St. Louis Div. 4s . .	1951	24,875.00	
14,000.00	Ozark Equipment Co. 5s	1910	14,000.00	
50,000.00	Northern Pac. Gt. Northern Joint 4s,	1921	48,500.00	
34,000.00	Baltimore & Ohio R.R. 3½s . . .	1925	30,090.00	
30,000.00	Chi., Mil. & St. Paul R.R. 7s . . .	1910	30,000.00	
52,000.00	N.Y. Cent. & H. R. R.R. (L. S.) 3½s,	1998	46,046.65	
50,000.00	Oregon Short Line 4s	1929	48,500.00	
5,000.00	Terminal Asso. St. Louis 4s	1953	5,000.00	
3,000.00	Lake Shore & Mich. Southern 4s .	1928	3,000.00	
	Advances to Bond Premium acc't .		33,597.00	
				1,417,139.11
	Amount carried up			$1,666,012.11

	Amount brought up				$1,666,012.11
	STOCKS.				
Shares.					
172	Boston & Albany R.R.	par	100	34,456.50	
80	Chi., Milwaukee & St. Paul R.R. Pf.	"	100	9,908.00	
50	Union Pacific R.R. Pref.			4,900.00	
12	Cocheco Manufacturing Co.	"	500	6,000.00	
56	Hamilton Woolen Co.	"	100	5,390.00	
31	Great Falls Manufacturing Co.	"	100	3,472.00	
2	Dwight Manufacturing Co.	"	500	1,600.00	
17	Pepperell Manufacturing Co.	"	100	2,789.50	
27	Essex Co.	"	50	3,780.00	
64	Boston Real Estate Trust	"	1000	68,605.64	
1	Boston Ground Rent Trust	"	1000	900.00	141,801.64
	INVESTMENT OF THE JOY SCHOLARSHIP FUND.				
	Massachusetts Hospital Life Insurance Co.			5,000.00	
	Deposits in Savings Banks			5,346.31	10,346.31
	INVESTMENT SWETT SCHOLARSHIP FUND.				
	Massachusetts Hospital Life Insurance Co.				10,000.00
	INVESTMENT OF RUSSEL FELLOWSHIP FUND.				
2,000.00	Conveyancers Title Ins. Co. Mortgage 4s .		1908		2,000.00
	Amount carried up				$1,830,160.06

Amount brought up		$1,830,160.06

REAL ESTATE.

Rogers Building	200,000.00	
Walker "	150,000.00	
Land on Garrison Street	50,840.00	
Mechanic Arts Building	30,000.00	80,840.00
Land on Trinity Place	76,315.69	
Engineering Bldg. A, Trinity Place	90,000.00	166,315.69
Gymnasium Building		3,953.26
Engineering Building, B		57,857.10
Engineering Building, C		47,561.08
Lot No. 2, Trinity Place		137,241.60
Lot No. 3, " "		282,286.35
Henry L. Pierce Building, Trinity Place		154,297.05
Boiler and Power House, " "		26,916.74
Clarendon St. Land and Building		142,762.94
Real Estate, Massachusetts Ave., Cambridge		16,154.38
Real Estate, Brookline, Mass.		112,964.32
Aug. Lowell Lab. Elec. Eng. Bldg., 1902		121,790.93 1,700,941.44
Equipment, Engineering Building		16,555.24
" Mechanical Laboratories		20,628.56
" Elec. Eng. Building		87,282.24 124,466.04

SUNDRIES.

Notes Receivable		12,000.00
Loans to Copley Society of Boston		6,999.99
Students' Notes		695.50
Physics Chem. Research Fund		525.28
Cash Balance, Sept. 30, 1905, less Oct. coupons		23,215.40 43,436.17
		$3,699,003.71

The foregoing property represents the following Funds and Balances, and is answerable for the same.

The income of the following is used for the general purposes of the Institute:—

William Barton Rogers Memorial Fund		250,225.00
Richard Perkins Fund		50,000.00
George Bucknam Dorr Fund		49,573.47
Martha Ann Edwards "		30,000.00
Nathaniel C. Nash "		10,000.00
Sidney Bartlett "		10,000.00
Robert E. Rogers "		7,680.77
Albion K. P. Welch "		5,000.00
Stanton Blake "		5,000.00
McGregor "		2,500.00
Katharine B. Lowell "		5,000.00
Samuel E. Sawyer "		4,764.40
John W. and Belinda L. Randall Fund		83,452.36
James Fund		163,654.21
George Robert Armstrong Fund		5,000.00
Arthur T. Lyman Fund		5,000.00 686,850.21
Amount carried up		$686,850.21

Amount brought up		686,850.21
The income of the following is used towards paying salaries:—		
Nathaniel Thayer, for Professorship of Physics .	25,000.00	
Jas. Hayward, for Professorship of Engineering,	18,800.00	
William P. Mason, " " Geology .	18,800.00	
Henry B. Rogers, for general salaries	25,000.00	
George A. Gardner, " "	20,000.00	
Sarah H. Forbes, salaries	500.00	108,100.00
SCHOLARSHIP TRUSTS.		
Richard Perkins Fund	53,363.61	
James Savage "	14,304.53	
Susan H. Swett "	10,332.95	
William Barton Rogers Fund	10,867.50	
Joy Fund	10,308.81	
Elisha Thatcher Loring Fund	5,400.75	
Charles Lewis Flint "	5,308.93	
Thomas Sherwin "	5,000.00	
Farnsworth "	5,000.00	
James H. Mirrlees "	2,869.29	
William F. Huntington "	5,253.45	
T. Sterry Hunt "	3,242.35	
Elisha Atkins "	5,000.00	
Nichols "	5,000.00	
Ann White Vose "	60,875.32	
Ann White Dickinson "	40,748.21	
Dalton Grad. Chemical "	5,739.09	
Willard B. Perkins "	6,919.28	
Billings Student "	50,000.00	
Henry Saltonstall "	10,000.00	
Isaac W. Danforth "	5,400.00	
Charles C. Nichols "	5,200.00	
Richard Lee Russel "	2,080.22	
Lucius Clapp "	4,900.00	333,114.29
OTHER TRUSTS.		
Charlotte Billings Richardson Ind. Chem. Fund,	37,378.78	
Susan Upham Fund	1,305.72	
Susan E. Dorr "	18,164.02	
William Hall Kerr Library Fund	2,000.00	
Charles Lewis Flint " "	5,000.00	
Rotch Architectural " "	5,000.00	
Rotch Architectural Fund	25,000.00	
Rotch Prize "	5,200.00	
Rotch "Special" Prize Fund	5,200.00	
Edward Austin "	376,476.72	
Teachers' "	106,400.00	
Saltonstall "	41,830.22	
Ednah Dow Cheney "	13,783.29	
Letter Box "	20.50	642,759.25
Aug. Lowell Lab. Electrical Eng. Fund		68,000.00
George B. Upton Legacy, 1905		5,000.00
M. I. T. Stock Account		1,816,645.92
MISCELLANEOUS.		
Cabot Medal Fund	206.25	
Walker Memorial Fund	8,562.96	
Roëntgen-Ray Experiment Fund	981.50	
Sanitary Research Laboratory Fund	2,853.57	
Dormitory Fund	2,694.20	
Students' Fees received in advance	16,860.00	
Supplies " " "	2,046.55	
Acc'ts Payable	4,329.01	38,534.0 4
		3,699,003.71

Comparative Statement of Funds, etc.

	Sept. 30, 1904.	Sept. 30, 1905.
Trusts for general purposes	686,850.21	686,850.21
" " Salaries	108,100.00	108,100.00
" " Scholarships	327,797.08	333,114.29
Other Trusts per page 9	627,443.24	642,759.25
Henry L. Pierce Legacy	848,000.00	
Arioch Wentworth Legacy	100,000.00	
Joseph B. Glover Legacy	5,000.00	
M. I. T. Stock Account	879,597.34	1,816,645.92
Aug. Lowell Lab. Electrical Eng. Fund	68,000.00	68,000.00
George B. Upton Legacy		5,000.00
Miscellaneous, per page 9	44,277.66	38,534.04
	$3,695,065.53	$3,699,003.71
Increase,		
Consisting of:		
Bequests for Special Purposes, etc. (See page 4),	22,333.22	
Gifts and Bequests for General Purposes. (See page 4)	5,000.00	
Net gain on Bonds sold	1,598.75	28,931.97
Less Expenses more than Income	10,582.32	
" Loss on Sale of Gymnasium	6,967.85	
" Teachers' Fund used,	1,700.00	
" paid on Miscellaneous	5,743.62	24,993.79
		$3,938.18

INCOME FROM GENERAL INVESTMENTS, AND APPLICATION THEREOF.

Applied to Salaries	4,324.00	From Bonds	63,769.95
" " Scholarships	10,375.00	" Dividends, Railroad Stocks	2,065.00
" " Fellowships	1,700.00	" " Manufacturing Stocks	1,431.00
" " Charlotte B. Richardson Fund	1,495.15	" Real Estate Stocks	2,915.00
" " Teachers' Fund	4,000.00		
" " Edward Austin Fund	14,400.00		
" " Rotch Prize Funds	400.00		
" " Rotch Architectural Fund	1,000.00		
" " Cheney Fund	49.97		
" " Library	480.00		
" " General Purposes	25,975.19		
" " Samuel Dorr Annuity	1,000.00		
" " Increase of Funds	712.64		
" " Advances to Bond Premiums	4,269.00		
	$70,180.95		$70,180.95

INCOME FROM WILLIAM BARTON ROGERS MEMORIAL FUND, AND APPLICATION THEREOF.

Paid Massachusetts Institute of Technology	10,815.00	Received Income from Railroad Bonds	11,483.00
Credited to Advances Bond Premiums	668.00		
	$11,483.00		$11,483.00

DETAILS OF SOME ITEMS IN TREASURER'S CASH ACCOUNT.

Rents.

Huntington Hall, for Lowell Lectures	3,500.00	
Land and Building, Clarendon St., on account	5,500.00	
Use of Rooms and Gymnasium	1,178.44	
Cambridge Real Estate	428.06	$10,606.50

Department Supplies

Applied Mechanics	1,436.52	
Architecture	1,307.36	
Biology	1,000.52	
Brookline Athletic Field	994.78	
Chemistry	14,019.42	
Civil Engineering	1,852.64	
Drawing	320.66	
Economics	400.02	
Electrical Engineering	3,272.45	
English	245.62	
Equipment Electric Chemistry	102.06	
General Library	2,000.00	
Geology	947.04	
History	599.64	
Mathematics	207.40	
Mechanic Arts	2,450.50	
Mechanical Engineering	2,521.30	
Military	210.62	
Mining	3,327.86	
Modern Languages	199.15	
Naval Architecture	1,197.33	
Physical Culture	79.10	
Physics	5,847.74	
Special Dynamo Plant	499.86	$45,039.59

Salaries.

Instruction	265,577.73	
Administration	39,119.23	
Labor	41,992.92	$346,689.88

General Expense.

Window Shades		52.52	
Furniture		631.25	
Stationery and Office Supplies		1,649.39	
Postage		1,172.80	
Electrical Wiring, Lamps, etc.		571.49	
Sundries		2,061.55	
Express		208.70	
Janitor's Supplies		1,437.47	
Examinations		499.25	
Diplomas and Commissions		732.85	
Washing		805.49	
Telephone Service, Installing Stations, Rentals, Repairs, etc.		1,195.98	
Engine Room Supplies:			
Oil	316.00		
Waste	110.75		
Sundries	123.11	549.86	
Ice		357.34	
Examination Books		230.36	
Graduation Exercises		125.55	
Removing Ashes		145.90	
Glass		66.14	
Union Safe Deposit Vaults (two years)		150.00	
Legal Services		2,341.72	
Medical Services		60.00	
Taxes, Brookline		393.75	
Technology Alumni		2,000.00	$17,439.36

Repairs.

Department Improvements:			
Architecture		115.16	
Biology		52.77	
Chemistry		1,169.94	
Civil Engineering		53.10	
Drawing		126.23	
Economics		31.80	
Electrical Engineering		785.41	
General Library		53.92	
Geology		134.80	
Mechanic Arts		94.59	
Mechanical Engineering		359.94	
Mining		188.35	
Modern Languages		8.50	
Naval Architecture		88.45	
Physical Culture		6.30	
Physics		572.85	3,842.11
Rogers Building			1,220.54
Walker "			388.60
Engineering Buildings, A and B			596.09
Pierce Building			209.66
Engineering Building, C			360.25
Lowell Building			935.69
Gymnasium Building			176.10
Mechanical Laboratories			118.15
Boiler and Power House			399.53
Tech. Union			12.31
Turbine Pump			450.00
Sundries			1,264.36
			$9,973.39

BOSTON, December 1, 1905.

Mr. Edward L. Parker, a public accountant, employed by this committee, has examined the accounts of the Treasurer of the MASSACHUSETTS INSTITUTE OF TECHNOLOGY for the year ended September 30, 1905, and has verified the Students' Notes and the cash at office and in banks, and his report is hereto annexed.

We have verified the list of securities held by the Institute.

CHARLES C. JACKSON, } *Members of the*
JAMES P. TOLMAN, } *Auditing Committee.*

BOSTON, December 1, 1905.

To the Auditing Committee of the
Massachusetts Institute of Technology:

GENTLEMEN,—I have audited the accounts of Mr. George Wigglesworth, Treasurer, for the year ended September 30, 1905.

They are correct, payments duly vouched, and the receipts from students' fees and all other income duly accounted for. The cash at office and in banks, according to the deposit books, is correct, and the Students' Notes are on hand. The account of property held by the Institute and the funds and balances, as shown in the Treasurer's report of September 30, 1905, is in accordance with the books.

Respectfully submitted,

EDWARD L. PARKER,
Public Accountant.

Volume 42. Number 2

BULLETIN

OF THE

Massachusetts Institute of Technology

BOSTON

REPORT

OF THE

PRESIDENT AND TREASURER

PRESENTED AT THE DECEMBER MEETING OF THE CORPORATION

JANUARY, 1907

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REPORT OF THE TREASURER

Members of the Corporation.

President.

HENRY S. PRITCHETT.

Secretary.

FRANCIS H. WILLIAMS

Treasurer.

GEORGE WIGGLESWORTH.

Life Members.

WILLIAM ENDICOTT.
HOWARD A. CARSON.
CHARLES J. PAINE.
CHARLES FAIRCHILD.
DAVID R. WHITNEY.
ALEXANDER S. WHEELER.
JAMES P. TOLMAN.
HOWARD STOCKTON.
NATHANIEL THAYER.
CHARLES F. CHOATE.
HIRAM F. MILLS.
PERCIVAL LOWELL.
CHARLES C. JACKSON.
SAMUEL M. FELTON.
DESMOND FITZGERALD.
FRANCIS BLAKE.
CHARLES W. HUBBARD.
THOMAS L. LIVERMORE.
A. LAWRENCE ROTCH.
JOHN R. FREEMAN.
WILLIAM H. LINCOLN.
J. B. SEWALL.
CHARLES L. LOVERING.
A. LAWRENCE LOWELL.
JAMES P. MUNROE.
WILLIAM L. PUTNAM.
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ROBERT S. PEABODY.
ELIHU THOMSON.
ELLIOT C. LEE.
JAMES P. STEARNS.
LUCIUS TUTTLE.
FREDERICK P. FISH.
FRANCIS L. HIGGINSON.
CHARLES A. STONE.
W. MURRAY CRANE.

Term Members.

Term expires March, 1909.

FREDERICK H. NEWELL.
RICHARD H. SOULE.
EBEN S. STEVENS.

Term expires March, 1910.

FREDERICK K. COPELAND.
JOSEPH P. GRAY.
FRANK L. LOCKE.

Term expires March, 1911.

THOMAS C. DU PONT
CHARLES T. MAIN.
FREDERICK W. WOOD.

On the Part of the Commonwealth.

His Excellency, CURTIS GUILD, Jr., *Governor.*
Hon. MARCUS P. KNOWLTON, *Chief Justice of the Supreme Court*
Hon. GEORGE H. MARTIN, *Secretary of the Board of Education.*

Committees of the Corporation.

Executive Committee.

HENRY S. PRITCHETT.
GEORGE WIGGLESWORTH. } *Ex Officio.*
FREDERICK W. WOOD. THOMAS L. LIVERMORE.
FRANCIS H. WILLIAMS. CHARLES A. STONE.
FREDERICK P. FISH.

Finance Committee.

WILLIAM ENDICOTT. NATHANIEL THAYER.
DAVID R. WHITNEY. CHARLES F. CHOATE.
CHARLES C. JACKSON. JAMES P. STEARNS.

Committee on the Society of Arts.

HOWARD A. CARSON. HIRAM F. MILLS.
ROBERT S. PEABODY.

Auditing Committee.

CHARLES C. JACKSON. JAMES P. TOLMAN.
WILLIAM L. PUTNAM.

Committee on Nominations.

DAVID R. WHITNEY. JAMES P. MUNROE.
HOWARD A. CARSON. CHARLES C. JACKSON.
FRANCIS H. WILLIAMS. CHARLES W. HUBBARD.

Trustees of the Museum of Fine Arts.

HENRY S. PRITCHETT. A. LAWRENCE ROTCH.
FRANCIS BLAKE.

VISITING COMMITTEES.

Department of Civil Engineering.

HOWARD A. CARSON.
CHARLES F. CHOATE.
DESMOND FITZGERALD.
JOHN R. FREEMAN.
LUCIUS TUTTLE.
FREDERICK H. NEWELL
JOSEPH P. GRAY.

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JAMES P. TOLMAN.
EBEN S. DRAPER.
ELLIOT C. LEE.
RICHARD H. SOULE.
FREDERICK K. COPELAND.

Departments of Mining and Geology.

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JAMES P. TOLMAN.
CHARLES L. LOVERING.
JAMES P. STEARNS.
THOMAS C. DU PONT.
FREDERICK W. WOOD.

Department of Architecture.

ROBERT S. PEABODY.
A. LAWRENCE ROTCH.
ALEXANDER S. WHEELER.
FRANCIS L. HIGGINSON.
JOHN R. FREEMAN.

Department of Physics.

A. LAWRENCE ROTCH.
FRANCIS BLAKE.
CHARLES W. HUBBARD.
ELIHU THOMSON.

Department of Electrical Engineering.

ELIHU THOMSON.
FRANCIS BLAKE.
FREDERICK P. FISH.
CHARLES A. STONE.
PERCIVAL LOWELL.
CHARLES T. MAIN.

Departments of Literature, History, and Political Economy.

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A. LAWRENCE LOWELL.
JAMES P. MUNROE.
J. B. SEWALL.
CHARLES L. LOVERING.

Departments of Modern Languages and English.

JAMES P. MUNROE.
J. B. SEWALL.
FRANK L. LOCKE.

Department of Mathematics.

PERCIVAL LOWELL.
HOWARD STOCKTON.
WILLIAM L. PUTNAM.
CHARLES F. CHOATE.

Departments of Chemistry and Chemical Engineering.

HIRAM F. MILLS.
ELIHU THOMSON.
ELLIOT C. LEE.
CHARLES W. HUBBARD.
W. MURRAY CRANE.
EBEN S. STEVENS.

Department of Biology.

JOHN R. FREEMAN.
FRANCIS BLAKE.
GEORGE H. MARTIN.
FRANCIS H. WILLIAMS.

Department of Naval Architecture.

CHARLES J. PAINE.
HOWARD STOCKTON.
WILLIAM H. LINCOLN

Report of the President.

To the Members of the Corporation:

The Report which I present to you to-day is the seventh annual Report which I have addressed to you. One year ago I presented to this body my resignation as President of the Institute, in order to undertake a work which, as it seemed to me, has the prospect of being far-reaching in its effects on American education. At that time nothing was further from my thought than that I should stand before you to-day as your President. This arrangement has been continued at the wish of the Executive Committee in order that certain problems should be advanced a little nearer completion, and in order that full time might be taken for the selection of a successor. The Executive Committee hopes to present to you, within a very brief period, a President of the Institute in my place; and that which I say now must therefore be said in the capacity of one who lays down the work rather than in the capacity of one who expects to carry it on.

CHANGES IN CORPORATION AND FACULTY.

During the past year there has been a number of changes in the Corporation of the Institute. We have lost by death Charles Merriam and Samuel Cabot, the latter called away in the midst of health and comparative youth. By resignation we have lost George A. Gardner and Thornton K. Lothrop, two men who have served the Massachusetts Institute of Technology long and well.

This year has marked the beginning of a new policy; that is, the election of members of the Alumni as term members. The following nine men have been by this means added to the Corporation: Frederick H. Newell, Richard H. Soule, Eben S. Stevens, for three years; Frederick K. Copeland, Joseph P. Gray, Frank L. Locke, for four years; Thomas C. du Pont, Charles T. Main, Frederick W. Wood, for five years.

In the Executive Committee there have been two resignations, those of Mr. A. Lawrence Lowell and of Mr. Howard Stockton. In the place of Mr. A. Lawrence Lowell, Mr. Charles A. Stone has been elected. The vacancy left by Mr. Howard Stockton remains yet to be filled.[1]

In the Faculty there have been the following changes: Associate Professor William L. Puffer in Electrical Engineering has resigned. The following associate professors have been appointed full professors: William O. Crosby, Frederick S. Woods, and Harry M. Goodwin. The following assistant professors have been appointed associate professors: Augustus H. Gill, Arthur G. Robbins, Frank A. Laws, Charles E. Fuller, William A. Johnston, Charles F. Park, and Frank P. McKibben. The following instructors have been appointed assistant professors: Nathan R. George, Archer T. Robinson, Charles E. Locke.

Two new appointments have been made of more than usual significance. The first is that of Professor Dugald C. Jackson to be Professor of Electrical Engineering and head of the Electrical Engineering Department. Professor Jackson comes to us from the University of Wisconsin, where he occupied a similar place and where he has built up the very successful school of electrical engineering which now exists in connection with that strong institution. He is a man who has combined in a successful way the practice of the engineering profession with the vocation of the teacher, a combination more and more called for in our schools of technology. A second appointment is that of Mr. George C. Shaad to the position of Assistant Pro-

[1] Filled at the meeting of December 12 by the election of Mr. Frederick W. Wood.

fessor of Electrical Engineering, in the place of Professor Puffer. Mr. Shaad also has had not only an experience in teaching, but an experience as well in the practice of his profession.

ADMINISTRATIVE CHANGES.

During the last year the Executive Committee has had under consideration at various times certain administrative changes looking toward a more definite assignment of duties among the various officers charged with administration. Until within the last few years there were only two administrative officers under the Executive Committee, the President and the Secretary. With the growth of the Institute, the increase in attendance, and the consequent enlargement of all its relations, the need of a larger administrative staff was felt. For years past Professor Tyler has combined the work of Secretary with that of head of a department. As Secretary he has had under his charge, not only the general correspondence and the work of administrative assistant to the President, but the work of Secretary of the Faculty as well, which involved membership in several important committees and supervision of correspondence which had to do with student reports and student standing. After careful consideration the Executive Committee has appointed a Secretary of the Institute, who serves as administrative assistant to the President and is in charge of the general correspondence and outside relations of the Institute. The duties of Secretary of the Faculty are performed by an officer who is elected by the Faculty, and who has to do with the immediate questions of student standing and reports and with the arrangements which the Faculty make with respect to such matters.

Professor Tyler, who has for many years performed an enormous amount of work in connection with all these duties, remains in charge of the Department of Mathematics, and expects to devote his entire time to the development of this important and fundamental branch of the work of the Institute.

To the position of Secretary of the Institute there has been appointed by the Executive Committee *pro tempore* Professor Dana P. Bartlett; and to the position of Secretary of the Faculty the Faculty has elected Professor Allyne L. Merrill. In taking this action, the Executive Committee has placed on record an expression of its high appreciation of the faithful and efficient service which Professor Tyler has rendered to the Institute in his long performance of the work of Secretary of the Institute and of Secretary of the Faculty.

THE RELATION OF THE CORPORATION TO THE GOVERNMENT OF THE INSTITUTE.

The addition of term members to the Corporation naturally suggests some consideration as to what constitutes the duty of a member of the Corporation and what function the Corporation itself ought to play in the government of the Institute.

In the early history of the Institute the Corporation was the sole body of government, and dealt directly with all the details of administration. The result was unsatisfactory. The membership of the Corporation is too large to admit of the effective transaction of business in such a way, and for this reason the By-laws were amended so as to provide for the Executive Committee, which, under the Corporation, now has charge of the details of administration. The creation of this body has had the tendency to carry the administration to the other extreme, and to intrust to the Executive Committee almost the entire direction of the institution.

The desirable administration lies, as it seems to me, somewhere between these two points. The Executive Committee should take immediate charge of the actual administration, but it is most desirable, as I view it, that the Corporation should not lose its function of passing upon all matters which have to do with the general policy and the larger purposes of the institution. During the past two years there have been submitted to the Corporation a number of such matters,—such as the consideration of the alliance with Harvard, and the proposal

to buy a new site,—and I am inclined to believe that in the discussion and settlement of such questions the Corporation will find increased interest and increased usefulness.

Another plan worth trying, it seems to me, is a modification of that which is used with great success in the Board of Trustees of the Carnegie Foundation for the Advancement of Teaching. These Trustees are a Board of twenty-five members, who are scattered over the United States and Canada, and whom it is most desirable to keep in close touch with the work of the Executive Committee. In order to effect this, the minutes of the Executive Committee are printed in full, with a free running comment on such matters as were considered, and are sent, after being printed, to all members of the Board of Trustees. It may well be that a modification of this plan, under which an abstract of the minutes of the Executive Committee might be prepared and sent to the members of the Corporation, would serve a similar purpose.

Since the addition of the term members, some of whom come from a distance, it seems increasingly desirable that some means should be adopted of informing members of the Corporation in advance of the nature of the business likely to come up for consideration at the regular meetings. It might serve the purpose, perhaps, if the President or the Secretary communicated to the members of the Corporation ten days in advance the nature of questions likely to arise.

In any body as large as the Corporation of the Institute which does not deal with the direct details of administration, the question of retaining the interest and the co-operation of the members is not always easy. Those in direct charge of the administration, with the best intentions, do not always understand that the man in the larger legislative body is likely to tire of an arrangement which does not involve actual duties and responsibilities. On the other hand, it is not desirable to bring before the larger body the details of administration which have to do with routine matters. Just how to combine the functions of these two bodies so as to preserve their mutual

interest is one of the things which those in charge of the government of the Institute need to consider.

STUDENT REGISTRATION.

In the very complete report of the Registrar will be found the usual statistics with respect to the registration of students, and a comparison with those of former years. The total number of students in the Institute is now thirteen hundred and ninety-seven as compared with fourteen hundred and sixty-six at the same time last year. This diminution is, however, but an apparent one. There was graduated last year the largest class which the Institute has ever sent out, two hundred and seventy-seven men receiving their diplomas in June, 1906. This was the class which entered just before the advance of tuition, four years ago. As the result of this increase, last year's senior class was the largest in the history of the Institute and this year's senior class is the smallest for some years. As a matter of fact, however, the number of new students in the Institute this year is five hundred and forty-six as compared with four hundred and eighty-two last year.

The number of students who are college graduates is two hundred, which is about the same number as last year. This includes fourteen who are fellows or candidates for the doctor's degree. The number of colleges and universities represented by this list is eighty-eight.

The student attendance continues to be representative of our whole country and of foreign countries. Forty-three states of the Union and one territory, besides the District of Columbia, Porto Rico, and the Philippines, are represented in the list of students. Of the whole number, thirteen hundred and ninety-seven, seven hundred and sixty-four, or fifty-five per cent. of the whole, are from the state of Massachusetts. States outside of Massachusetts which send the largest numbers are:—

New York	84	Maryland	17
Pennsylvania	55	Missouri	17
Illinois	37	Texas	15
Connecticut	36	Indiana	15
Ohio	30	Minnesota	14
New Hampshire	26	Iowa	14
Rhode Island	23	Colorado	12
California	21	District of Columbia	12
Maine	18		

From twenty-nine foreign countries there come seventy-six students. Of these the larger numbers are from the countries in the list which follows:—

Mexico	12	Cuba	4
China	7	Nova Scotia	4
England	6	Australia	3
Ontario	6	New Brunswick	3
Japan	5	Transvaal	3

The other countries represented are Argentine Republic, Armenia, Belgium, British Columbia, Bermuda, Cape Town, Chile, Denmark, Ecuador, Egypt, Honduras, India, Ireland, Jamaica, Peru, Quebec, Scotland, Turkey, and Uruguay.

THE CARNEGIE FOUNDATION FOR THE ADVANCEMENT OF TEACHING.

During the past year the Carnegie Foundation for the Advancement of Teaching has been inaugurated and has begun its active work.

This agency is likely to produce far-reaching effects upon American education, but its function and its significance are oftentimes misunderstood.

It is not an agency for the mere pensioning of superannuated professors. The foundation stands primarily for the idea that the time has come in the history of American education when it is important—not only important, but vital—to strengthen the position of the teacher and to make it attractive to strong men, men who have initiative, who have intellectual qualities, who have social attractiveness, and the ability to influence other

men. To use this large fund as a charity fund to take care of needy professors here and there would go a very short distance toward this purpose. Indeed, such a fund used as a charity is likely to do more harm than good.

The principles upon which those in charge of the fund have acted are essentially two.

1. The lifting from the teacher's life of the uncertainty which comes with old age and ill-health will counterbalance in many ways the smaller salary which goes and must continue properly to go with the teacher's calling.

2. In order that security and protection may appeal to the teacher, it must come to him as a right, not as a charity. No independent teacher desires, more than the man in any other calling, to be the recipient of charity; and, in order that the retiring allowance system may be an inducement to the best men, it must be offered to them on the same terms upon which they receive their salary and as a part of the academic compensation.

With these principles in view, the Trustees of the Carnegie Foundation for the Advancement of Teaching have gone to work to bring into the American educational system the principle of the retiring allowance to the professor in the higher institutions of learning. They have recognized some fifty-two institutions as entitled, by reason of fair standards and courses of study, to participation in this fund; and they will proceed to recognize other institutions in all parts of the United States and Canada as rapidly as this can be done with due regard to the educational standards and methods of the various sections. Among institutions thus admitted to the retiring allowance system is the Institute of Technology, so that our professors may now receive through the officers of the Institute a guarantee of the protection and the benefit of the retiring allowance system. The retiring allowance amounts, in the ordinary case, to about sixty per cent. of the active pay of the professor at the time of retirement; and under the rules of the Foundation the half of this amount is made available for the widow of the professor should she survive him.

How many institutions can be provided with an effective retiring system with the income of the Foundation is not yet absolutely determined. It may, perhaps, be set at one hundred and fifty. Denominational institutions are excluded and state institutions have not been admitted. It is clear, however, that, if such an effective system shall be inaugurated in one hundred and fifty representative colleges and universities scattered over the whole United States, the principle of the retiring allowance will be so thoroughly established that other institutions will find it necessary to make it a part of their academic system of compensation. How far-reaching this result will be in strengthening the profession of the teacher and attracting to it strong men, only those can know who have seen the uncomfortable effects of the lack of such protection in the past.

DEVELOPMENT FOR THE FUTURE.

For some years I have called attention in my annual Reports to the need of outlining as definitely as possible the policy of the Institute with respect to certain fundamental questions. These fundamental questions seem to me, in the order of their importance, to be the following:—

1. The development of the intellectual work of the Institute. This work is essentially that of the Faculty and of the President. It involves not only the carrying on of the present courses of instruction, but the examination, year by year, of the fitness of these courses to do the work for which they are intended. It involves the quickening of the means of instruction and the adaptation of the courses to student needs. During the last twenty years there has been a continual tendency to differentiate technical education to meet the demands of the subdivisions of engineering. This tendency has probably gone too far, and we need perhaps to-day to return to greater simplicity and the teaching of fundamental sciences.

2. The second problem which stands immediately before the government of the Institute is that of the settlement of the

question of its location during the next fifteen or twenty years. This should be settled at the earliest practicable moment, in order that those who have to provide for the Institute and to work for its advancement may work with definiteness of aim and with understanding of what its future is to be.

3. Having settled these fundamental questions, this Corporation needs next to consider the means of providing money for endowment and for buildings so as to make the selected site the seat of an effective and well-equipped group of engineering buildings.

EDUCATIONAL TENDENCIES.

Those who have to do with colleges of technology must admit frankly that, when these institutions undertake to give in four years the foundations of a general education and a technical training as well, they undertake a most difficult task. Out of these difficulties there has grown in the last ten years a marked tendency to give to those boys who can afford the time and have the means, first, the education of the college and, secondly, the training of the technical school. In all institutions of technology to-day a considerable proportion of students who enter have had their general college course before they come, and they enter the school of applied science as a professional school, much as students enter the medical school or the law school. The number of such students is growing. Under this tendency there will gradually be differentiated two classes of technological institutions: one, the undergraduate institution, similar to the technical college of to-day, aiming to give a technical training and so much of a general education as is possible in four years; the other, a graduate school of applied science, intended for men whose work is wholly professional and who have had already a general education. The present epoch is, therefore, one of transition for the college of technology, and we may safely anticipate in the next decade some sort of crystallization along the lines which I have just mentioned.

This tendency stands directly across the path of the Institute of Technology and is a real problem for it to meet. There are to be in this community—for Cambridge is practically a part of the community of Greater Boston—at least two high-grade technical schools of applied science. A third, in the suburbs of Boston,—at Tufts College,—is growing rapidly in numbers and in efficiency. Just what form of development and what form of leadership the Institute of Technology will seek under these tendencies is a question of vital importance so far as its future standing among the institutions of the country is concerned.

It seems to me clear that for the present and for many years to come the Institute of Technology must give the greater part of its effort to undergraduate instruction. It seems, however, equally clear that, if it is to retain any large measure of leadership, it must develop at the same time graduate and research work. To compass these two somewhat dissimilar aims in the same institution is not easy. Perhaps the best purpose I can serve at this moment is to call your attention to the existence of these tendencies, and to the fact that your choice of the policy of the Institute is likely to have an important bearing upon its future standing according as its work tends to a purely undergraduate school or as it tends to include a fair measure of graduate work and of research.

No one familiar with our schools of technology can doubt that an institution devoted to the work of applied science, professional in its character, and requiring a bachelor's degree for admission, would present great attractions to students already graduates of colleges. The greater freedom possible in such institutions is in itself a considerable factor. Furthermore, the man who has passed through his freshman and sophomore years, and been graduated from a college with the dignity of a senior, finds it more or less trying to take up again college work in the company of men just entering. From every standpoint it is clear that professional graduate schools in applied science would appeal to a large number of the very best men.

CULTURE STUDIES IN TECHNICAL SCHOOLS.

Twenty years ago schools of technology were criticised on the ground that they taught men to make a living rather than to live. In response to this criticism, many schools of applied science—of which the Institute was a leader—have added to their courses of study a growing amount of so-called "culture" studies. I think I express the opinion of many teachers in saying that the result has not been all that might be hoped for. These culture studies have consisted generally of English, History, Economics, and Modern Languages. All these are studies of great importance and of real humanitarian and cultural value if studied in the right spirit and under favorable circumstances. Their value to the student in the technical college has been of varying importance, depending partly on the atmosphere of the technical school itself, partly on the lack of thoroughness in the secondary schools.

The very earnestness which pervades a technical school, the spirit which prompts the student to bend himself to the task before him, tends to place a light value on any studies which do not lead to visible results. It is difficult to convince him that such subjects have for him a value comparable with the more direct utilitarian subjects; and to study them in this atmosphere and with this spirit is to achieve a very much smaller result than would be possible in a different atmosphere and with a different spirit.

As a matter of fact, we men in the college of technology need to recognize that it is not the study of Literature, nor of Economics, nor of History, nor of any other subject, that *per se* brings culture and a broad sympathy with men. Chemistry, Physics, and Mechanics may be taught in such a way as to develop great humanistic interests as effectively as any of the so-called culture studies. The fact that we need to lay to heart is that the thing which brings true culture to men is intercourse with other men of culture, acquaintance with the thoughts of great men, either through the medium of books or

through the words of living men. It is the rubbing of one student against another. If we desire to increase in our colleges of technology a spirit of true culture and to bring about a larger common interest, the effective way to do this is to bring into our colleges teachers who are themselves exponents of this culture and of this wide human interest.

A CLOSER CONTACT WITH INDUSTRIAL INTERESTS.

Forty years ago engineering schools of the United States were started by teachers. It is no small credit to the prevision of the American teacher that he should have been the man to recognize the need for industrial education. The Institute of Technology was started, not through the efforts of a practical man of business, but through the effort and wise foresight of WILLIAM BARTON ROGERS, a teacher and an investigator. He saw clearly, as few business men saw at that day, the purpose that such education would serve.

At first manufacturers and others who employed skilled engineers hesitated to accept the graduates of the technical school; but to-day they accept them readily, and the supply is not so large as the demand. Nevertheless, there is still found an echo of the fact that the contact between the school of engineering and the manufacturing establishment is not so close as it ought to be. The following instructions in a large manufacturing establishment illustrate the feeling in this matter. These instructions were to give the preference, first, to graduates of technical schools; second, to the graduates of academic colleges; but, third, to employ no college boy who had not been out of college for more than two years.

In a word, our colleges of technology started forty years ago were started, not in actual co-operation with manufacturing establishments, but in practical disregard of them; and, notwithstanding the success of the college of technology, it still remains true that we have yet in this country to secure an efficient contact between industry and applied science, between

the factory and the school. There is to-day no such relation, for example, between the school of Industrial Chemistry and the chemical industry in the United States as exists between the school of Industrial Chemistry and the chemical industry in Germany.

This contact needs to be shown in two ways: first, by a real appreciation on the part of the teacher of the view-point of the manufacturer and business man; secondly, by securing the actual interest of the manufacturer in the school. The first point is one which is receiving increasing attention in our schools of technology to-day, but which needs still greater elaboration and study. Various devices are being tried in institutions of learning to induce men who have close touch with engineering and applied science to take the work of professors or to assist those who are already professors to get in touch with practice. In Cornell, for instance, an arrangement has been made under which professors may spend three years in practice, returning afterwards to the school. All these efforts grow out of a keen appreciation of the lack amongst professors of contact with practical work.

It is to be remembered that the chief purpose of the school of technology is to train practitioners in applied science, just as it is the chief purpose of the medical school to train practitioners in medicine. It is necessary that there should be that about the technical school which may encourage and inspire the small minority of those who come to the life of the teacher and investigator; but the main purpose of the school is that which I have mentioned. For this reason it is important that the student should have the view-point of the practitioner of engineering, just as it is important that the medical student should have the view-point of the practitioner of medicine; and, to bring this about, the teacher in the technical school should himself be a practitioner, just as the teacher in the medical school usually is. It is one of the advantages in the teaching of medicine that the practice may be so readily brought into the clinic before the students; and we may well imagine what sort of

physicians and surgeons would be turned out if their instruction lay wholly in the hands of men who were teachers rather than practitioners.

To bring about a closer contact with the manufacturer and to secure the real interest of the man of business in the school of technology is also a vital need of applied science at this time. The college in the United States presents too often to the business man the attitude of the persistent beggar rather than the attitude of a co-laborer and sharer in industrial problems. How to assure closer contact with industry and business is a problem which the school of technology of the next ten years must closely study.

One way of securing this closer relation, as it seems to me, would be to develop the practical service of the school to the industrial interests of the Commonwealth and of the nation. For instance, the development of the great testing and research laboratory at Charlottenburg in connection with the school of technology has been an enormous factor in cementing together the school and the industries which it seeks to serve.

THE TREASURER'S REPORT.

The Report of the Treasurer has been printed and has been mailed in advance of this meeting to members of the Corporation. This Report shows that the receipts for current expenses have amounted during the year to $504,511. This includes $42,583.61 received from the Income Fund Committee. The expenditures have amounted to $508,407.21, which shows a deficit of $3,896.21. Without the contribution from the Alumni the deficit would have been approximately $46,000.

The Report shows, further, gifts for special purposes amounting to $31,543.88, and gifts and bequests for general purposes amounting to $50,043.18. The net result of the whole year is an addition to the property of the Institute of $86,865.85. The Walker Memorial Fund now amounts to $107,557.06, in addition to which there are certain large gifts in connection with

it which may be called for whenever the Corporation is ready to assign a site for the erection of the building.

REPORTS OF DEPARTMENTS.

I beg to call the attention of the Corporation to the reports presented by the heads of departments and to ask their careful consideration of them. It has been our plan for some years past to ask heads of departments to present specifically their own recommendations as to the development and needs of their respective departments. It has seemed to me desirable that these matters should be presented to the Corporation in this formal way by the heads of departments themselves, and I ask for all of them a careful reading.

In addition to the general questions there brought forward, I call your attention to the following points. For some time it has been evident that the pressure upon the student's time must be relieved, and a number of suggestions has been under consideration by the Faculty for doing this. In the report of the head of the Department of Civil Engineering is a recommendation looking toward a summer school for the teaching of surveying in which the whole work of instruction in surveying should be done in the summer rather than during the year. I consider this recommendation a most important one, and one which should receive early consideration.

I call the attention of the Corporation to the statement of the head of the Department of Mechanical Engineering in relation to the need for more room. The Executive Committee has granted to this department a much-needed sum for new apparatus, but this very grant increases the pressure for room already keenly felt and calls special attention to the need of a general solution of the whole question of site and buildings for the immediate future of the Institute.

Attention is called in the report of the head of the Department of Mining Engineering and Metallurgy to the very effective work of the summer school and the means adopted in it

to bring students of that department in touch with actual engineering problems. This statement emphasizes again the need for some systematic consideration of the matter of summer instruction. For a single year there was provided, through the generosity of a donor in New York, means by which students in the Mining Departments of the Institute, of Harvard, Yale, and Columbia, were enabled to unite in a summer school in a Colorado mine. Some means by which instruction in practical mining may be afforded students without large expense is an urgent need.

Besides other important recommendations, the head of the Department of Chemistry and Chemical Engineering again calls attention to the fact that the work of the department is scattered through a number of buildings, a recommendation which again emphasizes the necessity of the solution of the question of room and buildings.

The report of the head of the Department of Biology calls attention, not alone to the actual work of the department, but to the conduct of the Sanitary Research Laboratory and Sewage Experiment Station maintained by the generosity of an anonymous donor. This department is perhaps in closer touch with the industrial and sanitary work of the Commonwealth than most friends of the Institute realize. During the past year a member of the department has made a most valuable report in relation to sewage problems connected with the work of the Charles River Basin; and questions of an immediate practical sort are constantly being dealt with by members of this departmental staff. The work of an engineer who has had training in Biology is becoming increasingly important in this country, and it would seem that the facilities afforded at the Institute of Technology for such men ought to win an increasing number of students.

The head of the Department of Geology brings out in an interesting way the service which this department renders to that of Mining, and calls attention also, as has already been noted in other cases, to the pressing need of additional room.

The head of the Department of Naval Architecture submits, in addition to his ordinary report, a report of a visitation made to the ship-yards, colleges, navy-yards, and ship-model stations of Europe which is of great value and interest.

In the report of the head of the Department of Mathematics attention is called to the revision of the courses in Mathematics, a revision tending to bring fundamental mathematical courses to the better adaptation and to the better study of Mathematics, and thereby to place the tools of Mathematics in the hands of the students at an earlier age and more effectively. I consider this work one of the very greatest importance. Connected with it, and equally fundamental and important, is the work in Applied Mechanics, and in Drawing and Descriptive Geometry.

The Corporation will be interested in the report of the head of the Department of English as to the results of the first trial of entrance examinations under the new conditions. This new condition consisted in doing away, in the preparatory work, with the arbitrary requirement of a list of prescribed books, and granting permission to the teachers in the preparatory school to choose such works of literature as seem to them adapted to the needs of individual classes. This year's examinations seem to the department to furnish solid ground for hope that the results are in the direction of a better training and of a more real interest in such subjects.

The reports of the Secretary of the Faculty, of the Dean, of the Registrar, and of the Medical Examiner contain material of the greatest interest and value, and I commend them to your examination.

HENRY S. PRITCHETT.

DECEMBER 11, 1906.

Reports of Departments.

DEPARTMENTS OF CIVIL ENGINEERING AND SANITARY ENGINEERING.

During the past year there has been made in the Courses in Civil and Sanitary Engineering a very important change, which goes into effect with the present sophomore class. The chief alteration involved consists in the omission from these Courses of one year of Modern Languages. In the future, a student in these Courses will therefore be required to study Modern Languages during the first year only. He will enter, as now required, with elementary French and elementary German, and during the first year will take more advanced work in whichever of these languages he may select.

The necessity for this change has been pressing for many years, owing to the increasing demands made by other subjects of study, and by reason of the comparatively small use of Modern Languages which most graduates of these Courses make in their professional work. Furthermore, students who desire it can still continue the study of Modern Languages as an optional study in the third year or in the Summer School, so that the Institute still offers opportunity to students who desire it to obtain as much instruction in these subjects as formerly.

The pressing need for time in Courses I. and XI. arose from the desirability of devoting more time to the study of Mechanics, and of beginning that subject earlier, so as to avoid any intermission between the Physics of the second year and the Mechanics of the third year. Beginning with this year, students in these Courses will begin the study of Mechanics at the middle

of the second year; and this subject, together with that of Structures, will be one connected, continuous course. No new subjects have been introduced, but more time is to be given to those which are already taught, and it is hoped that a great increase in efficiency will follow.

Instructor S. H. Thorndike resigned his position at the close of last year, and his work has been distributed among the other members of the staff. The usual number of changes among the assistants has taken place, but no change has been made among the members of the Faculty.

In connection with the attempt which is being made to attract to the Institute more college graduates, and to offer more advanced work, that is to say, work in advance of that given in our regular four-year Course, the necessity becomes apparent of adding to the number of instructors of high grade. The present members of the instructing force, with the large classes now attending, have their time well filled, and any considerable increase in the number of courses of instruction is well-nigh impracticable.

The most serious problem confronting these Departments at the present time relates to the proper conduct of work in the field. There are two methods of carrying on such work: first, by making it a part of the regular work of the school year; and, second, by concentrating it in a separate school during the summer.

The Institute has thus far adhered to the first method. In the early days, when classes were small and when the Back Bay was not built up, this instruction could be given near at hand without waste of time; but it soon became necessary to take the classes into the country in order to carry on the work effectively. This necessitated devoting more time than a single afternoon to each exercise, and led to a change, which was put into force many years ago, by which an entire day in each week was assigned to field work for the second-year students, and another entire day in each week to field work for the third-year students. As the classes increased, it became

necessary to divide them into sections, and to assign two entire days of each week to the field work of the second year. During the winter, when field work is impracticable, the work of plotting and computing is carried on in the drawing-room.

With still increasing numbers of students, and especially with the increasing pressure in the curriculum of other subjects to which more time ought to be devoted than has been found possible in the past, the question of the proper method of conducting field work, and of the possibility of saving some of the time now devoted to it during the school year, becomes a very pressing one.

In some other schools in this country the field work is given during the summer, leaving the school year free for work of other kinds. Harvard, Columbia, Cornell, and other institutions follow this plan.

The advantages of carrying on the field work during the school year may perhaps be summarized as follows:

(1) The arrangement of the curriculum is somewhat simplified, for the class-room work and the field work can be arranged with close reference to each other and to the other subjects in the Course.

(2) The summer is left free for students and instructors, a fact which enables them both to devote the time to professional work. Many of the students depend upon earning enough money during the summer to go far toward paying their tuition for the following year.

(3) It avoids the necessity of securing a site, and the trouble and expense of carrying on a summer camp, and of feeding, housing, and taking care of a large number of students.

(4) It avoids the necessity of charging an extra fee for summer work (as is generally done in other schools), a plan which makes the Course in Civil Engineering more expensive to students than other Courses in the school.

The advantages of a summer school for field work may be summarized as follows:—

(1) By concentrating the field work during six or eight weeks

in the summer, the school year is left free for the many other pressing subjects which demand attention.

(2) The student is not distracted from his more purely mental work during the school year by the necessity of giving a day each week, perhaps in inclement weather, to work in the field, which may leave him physically tired out, if not exhausted, and interferes with the preparation of lessons for the following day.

(3) It simplifies the arrangement of the tabular view, and releases a large amount of time during the school year.

(4) The concentration of the work in the field should be attended with an increase in efficiency.

With reference to expense, it is probable that the summer school method would prove more expensive than the plan now followed. It would require the Institute to procure a suitable location, involving the use of a large area of land to be surveyed, at some point in the country where the topography is diversified, where a railway line several miles in length might be laid out, and where there is a running stream large enough for efficient work in Hydraulic Measurements. A camp would have to be organized and administered, buildings constructed, and food and shelter provided for a large number of students. The number of instructors would also have to be large, and it might prove difficult to secure a sufficient number of properly trained men. Students from the graduating class might be induced to assist us for two months in the summer, and yet the demand for our graduates is greatest just at the close of the school year, and the temptation to accept favorable offers is likely to be so strong that the best students will yield to it. On the other hand, the number of assistants required in the Department during the school year would probably be reduced, since a considerable proportion of the time of assistants at present is devoted to field work, so that, if the number of assistants is sufficient in the early fall and late spring when field work is carried on, there is a slight excess during the winter. I do not believe, however, that the number of assistants in these Departments should be materially reduced in case the

summer school method should be adopted. The increased expense to the Institute may be met by a fee charged to all students. I am informed that the Harvard Summer School, which is held at Squam Lake, N.H., and for which the fee is about $20, exclusive of board, pays for itself and is very successful.

As a result of these considerations, and after much discussion, I believe that it is desirable that the Corporation should give immediate and serious attention to the question of inaugurating a summer school for field work which all students in Civil Engineering should be required to attend. Some changes in the courses of study would be required, but I think it would be found necessary to require students to attend such a school only during the vacation following the second year. During six or eight weeks of continuous work they ought to complete the field work in Surveying and in Railroad Engineering, and the hydraulic field work, leaving for the work of the term only the study of methods and instruments, and, to some extent, the plotting of results.

I recommend, therefore, that the Corporation give immediate and serious consideration to the question of securing a proper permanent location for such a summer school and to supplying the means of carrying it on.

It may be added that the desirability of such action will not be obviated by the removal of the Institute to any other location in the immediate vicinity of the present site. Indeed, owing to the close proximity of our present site to the railroad stations, a removal would be very likely to increase the desirability of the summer school plan. The summer school, if it is to secure the best results, should be in the country at some place similar to that where the Harvard school is located.

The Department has reason to feel much encouraged by another instance recently brought to our notice of the excellent showing which our graduates make in competitive examinations. Some years ago mention was made of the high rank obtained by graduates of the Department in examinations for the

position of Civil Engineer in the United States Navy and in the Geological Survey. The latest instance is the examination, held a few months ago, for the position of Assistant Engineer for the Board of Water Supply of New York. A grade of seventy per cent., based partly on experience, etc., was required for passing. There was a large number of applicants, and one hundred and fifty of them were successful. Of this number five out of the leading six (all but No. 3) were graduates of Courses I. and XI., and nineteen were former students of these Courses, including one non-graduate.

It is interesting to observe in this connection that the school credited with the next largest number of men who were successful in this examination was the Cooper Union. The figures at hand are not complete, and I am not able to state how many Institute men failed, if any, as compared with those who passed, but it is clear that our graduates make a good showing when put to such tests as these. It is also clear that young men working for themselves and paying their own way, like most of the students at Cooper Union, may also be very successful.

GEORGE F. SWAIN.

DEPARTMENTS OF MECHANICAL ENGINEERING AND APPLIED MECHANICS.

The number of students in the last graduating class of the Course in Mechanical Engineering was exceptionally large, there being sixty-nine graduates. This large class, together with the fact that these Departments are called upon to provide a very considerable amount of instruction for the students of Courses I., II., III., IV., VI., VIII., X., XI., and XIII., as well as the consequently large amount of investigation carried on, especially in connection with the thesis work, not only of Course II., but also of some of the other Courses, has taxed the resources of these Departments to their utmost, especially in the Laboratories, where the supply of additional apparatus has not

kept up with the needs. Indeed, it was for a time a serious question whether we should be forced to decrease the amount of instruction given to each student, especially in the higher and more purely professional portions of the work; and we have been obliged to have a larger amount of thesis work than is desirable performed outside of the Institute.

The improvements in the Course in Mechanical Engineering mentioned in the President's Report of January, 1906, have proved to be of great value in increasing the usefulness of the Course, and in aiding us materially to keep it more and more in touch with the needs of the times, and with the live engineering questions of the day. Among these improvements may be especially mentioned the increased time devoted to each of the fourth-year Options, the addition of work in power plant design, and the greater amount of instruction in Electrical Engineering subjects.

The practice of these laboratories in carrying on a considerable amount of investigation of modern engineering problems has been, as usual, continued. In this connection may be mentioned the following portion of the thesis work of the past year:—

(*a*) The investigations upon the strength of locomotive connecting rods have been continued, including tests made upon a number of large rods.

(*b*) Inasmuch as many railroads and locomotive works are encountering difficulties with the breakage of springs, an experimental study of the loads to which driving springs are subjected in service was carried on.

(*c*) There were made seventeen tests of large power plants, including five tests of steam turbine plants varying in capacity from five hundred to five thousand kilowatts, four tests of pumping plants, two of producer gas plants, and one of the engine and boiler plant of a cotton mill.

(*d*) Work upon concrete and reinforced concrete has been continued.

(*e*) Various other modern engineering problems have been investigated.

(*f*) During the last summer a thesis was carried on, the object of which was the comparison of the performance of a large passenger locomotive provided with a superheater, with that of a similar engine without a superheater, involving complete road tests of the two engines, on runs of over one hundred miles. The application of superheaters is a practice recently introduced on some railroads.

Several members of the instructing staff were employed during the summer in outside work in connection with the erection of structures of reinforced concrete.

The following gifts have been made to the Department:

(*a*) A plunger pump, by the Douglas Pump Company.

(*b*) Portions of a machine for balancing card cylinders, by the Saco and Pettee Machine Works, Newton, Mass.

(*c*) Complete sets of blue prints of locomotives by the American Locomotive Company, and by Mr. Harvey Middleton.

(*d*) Considerable data, such as specifications, and other literature has been provided for the use of the students, by the American Locomotive Company, by the Baldwin Locomotive Company, by the Crosby Steam Gage Company, and by the R. D. Wood Company, makers of gas producers.

(*e*) In connection with the thesis work on the strength of connecting rods, twelve large rods, worth about eighty dollars each, were presented to the Department for the purposes of the tests, by the Baldwin Locomotive Company.

(*f*) Valuable modern apparatus has been lent to the Department for use in connection with the work in the drawing-room by the J. Stevens Arms and Tool Company, the Ridgway Dynamo and Engine Company, and the Baush Machine Tool Company.

The urgent need of a considerable amount of additional apparatus, and the fact that until last June no special appropriation for the purpose had been made since 1900, has been frequently mentioned. It will not be repeated here, except to say

that a special appropriation of eight thousand three hundred dollars was made last June for this purpose, which will enable us to add some new apparatus to the laboratory, though much more is urgently needed.

More room is also needed for new apparatus, to relieve present crowding, to furnish room for students to carry on thesis work on apparatus brought in from outside, to provide storage room for large and miscellaneous apparatus to be used on thesis work conducted outside, and to provide room for stripping machines for the purposes of Machine Drawing.

GAETANO LANZA.

DEPARTMENT OF MINING ENGINEERING AND METALLURGY.

The John Cummings Laboratories of Mining Engineering and Metallurgy are constantly being developed to bring the student into intimate contact with the latest ideas in ore-dressing and metallurgy. In the Ore-dressing Laboratory a new jig, of the pattern approved in the Michigan copper concentrating works, is being constructed. In addition the Harz jig has received new automatic discharges, a new canvas table has just been supplied, and the Wetherill magnet is being improved.

In the furnace room a hydraulic elevator has been installed to raise materials from the bins to the main floor of the laboratory. An iron structure to handle the Devereux slag-pots has replaced the wooden one formerly used. Part of the floor has been cemented to facilitate the handling of pots filled with melted slag. In order to save time in the repair of the test used for refining copper, special forms of brick are now used, a plan which does away with the cutting of tiles to suitable sizes.

In the Metallographical Laboratory the addition of a gas furnace, an automatic recording pyrometer, and a dark room are contemplated for work on metals and alloys.

The office and library had become so crowded that relief was imperative. Space was obtained by utilizing room reserved

for the museum, and distributing the specimens. In the former museum the floor, which was five feet eleven inches from the basement, was raised two feet four inches, dividing the available space into a lower room six feet eleven inches high and an upper room nine feet six inches high. In the lower room, lighted and ventilated electrically, all the apparatus of the Metallographical Laboratory and eight show-cases of specimens are placed. In the upper room is the library of the Department. Here are the office of Professor Hofman and the desks of his three assistants. The small cases in the old library are filled with collections representing mining districts. This room serves now as office for three assistants. The original office is occupied by Professors Richards and Locke.

Professor Richards has recently presented to the library of the Department from his own library one hundred and thirty-two books and pamphlets which the former did not contain.

In the Assaying Laboratory all the balances have been overhauled and put in thorough repair. The assistants' office, formerly overcrowded, has been relieved by the library changes.

Among changes in the work of instruction may be mentioned the fact that the exercise in Laboratory Reports has been enlarged by requiring the students to make written reports on all the work that they have done in the three sections into which they are divided.

Memoirs, which used to be given once a week during both terms of the fourth year, are now given, through force of circumstances, twice a week during the second term only. The result will be watched with interest.

The number of students is not quite so large as last year, owing to the departure of the phenomenal class of 1906. The numbers in the fourth year, the third year, and the second year are respectively twenty-eight, thirty, and thirty-six.

Charles E. Locke has been promoted from Instructor to Assistant Professor of Mining Engineering and Metallurgy. Carle R. Hayward, teacher at Bellows Academy, Fairfax, Vt., has been appointed Instructor in Metallurgy, in place of

Robert Faulkner, who has gone to the National Tube Works, McKeesport, Pa. Arthur P. Watt has been appointed Assistant in place of George A. Barnaby, who is surveying in Peabody, Mass. John A. Root has been appointed Assistant in place of Moses Brown, Jr., who is surveying in the copper country at Lake Superior.

Last year Professor Sauveur resigned his position as lecturer and demonstrator in Metallography. The subject is now in charge of Professor Hofman, who gives the lectures and conducts the laboratory exercises.

Professor Richards is engaged in writing an appendix to his work on Ore-dressing, and Professor Hofman is at work on a treatise on Metallurgy. Professor Richards has also been acting in the capacity of consulting engineer for works in Pennsylvania, Virginia, Missouri, Colorado, and Oregon. He is at present investigating the rate of settling of mineral grains in water, and also the laws governing the design of hydraulic classifiers, and of the Wilfley concentrating table.

During the summer Professor Lodge attended the meeting of the American Institute of Mining Engineers, which was held jointly with the British Iron and Steel Institute in England. Professor Locke made an extensive trip among the mines of New England and Eastern Canada.

The Summer School, in charge of Professors Richards and Locke, and joined later by Professor Hofman, was held in New York, Ohio, Minnesota, Michigan, and Ontario. It included, besides the instructing staff, one graduate, three fourth-year men, two third-year, and two second-year men. Among the industries visited at Niagara were the Acheson Graphite Company, the Carborundum Company, the Niagara Falls Power Company, and the Hydraulic Power Manufacturing Company. A most enjoyable journey from Ashtabula to Duluth was made in the ore steamer "John J. Allbright." In the Mesabi region of Minnesota, at Hibbing, the Burt Poole mine and the Mahoning mine were visited. These are monster open pit mines of iron ore. At

Duluth the party inspected the great ore docks. At Ironwood, Michigan, the Newport deep mine of iron ore was studied inside and out, and the surface plant of the Norrie mine. At Iron Mountain the Chapin deep mine of iron ore was studied and also the power plant and compressed air pipe line. In the copper country the Champion and Trimountain mills were studied. The party went into the Baltic mine and made a study of it. They visited the Osceola and Quincy mills, and the surface plants of the Calumet and Hecla and the Tamarack mines, the Michigan smelter, and the Calumet and Hecla smelter. Professor Locke also made a visit to the Victoria hydraulic power plant. The party next took the passenger steamer to Sault Ste. Marie, where they studied the blast furnaces, the steel plant, the electric iron furnace, and the charcoal plant of the Algoma Steel Company. The next move was to Sudbury, Ontario, where were visited the Crean Hill mine and the Creighton mines of the Canadian Copper Company and the Victoria mine of the Mond Nickel Company, together with the smelting works of both these companies.

The Department desires to record here its thanks for the generous and cordial welcome given to the students of the Summer School by the managers of the above-mentioned companies and firms, and for the many courtesies extended by former graduates and others.

Several undergraduates were employed in mines and at furnaces during the summer vacation. One went to Colorado, seven to Cape Breton, three to Montana, two to Missouri, two to New York, three to Utah, and one to Alaska.

The demand for graduates is still active. The Department could have placed more than the large number graduating in 1906. This is especially true of places in iron and steel metallurgy.

ROBERT H. RICHARDS.

DEPARTMENT OF ARCHITECTURE.

This year the new Course Scheme made possible by the increased entrance requirements in Modern Languages is for the first time in complete operation. The two hundred and seventy hours which became available for additional general and professional work have opened the way for many modifications and improvements in the courses given by the Department, that promise well in the direction of greater efficiency in methods of teaching, and a general broadening of the Course. A generous proportion of the added time has been devoted to an increase in the structural subjects taught in Options I. and II. These changes have, on the other hand, very largely extended the labors of Professor Lawrence, who had all that he ought to carry before. As these hours represent class work, and as the instruction is practically all with individual students, each of whom may be working on a different problem in the same class, it is evident that the demand upon his time has been so materially increased that he should have aid to help him in routine work, and so give him the opportunity to do full justice in the way of extension or improvement to the courses of instruction under his charge. Undoubtedly, an assistant could be secured from the graduating class to serve next year, and I hope this will be allowed.

More applications come for graduates from Option II. than it is possible to meet, and the reputations of those offering these positions are sufficient proofs of the high consideration in which these graduates are held. This standard we are bound to maintain.

The good results that have attended the union of third and fourth-year students in a common drawing-room have made it highly desirable that the second-year students should have part in the same arrangement. Unfortunately, our limited floor area on a single story makes this impossible of accomplish-

ment, but it increases the desire for new quarters planned to profit by the experience in teaching gained during these many years. The younger men would mature more quickly but for their isolation. They need the stimulus gained by close association with men stronger than themselves, and they would more fully appreciate how much their own work stands for if they could watch more closely its theory put in practice by those who have had a year's start of them. The third and fourth-year men now meet on a common ground. They help each other in many ways. They work on each other's drawings, and they criticise each other's designs. This association seems to develop more quickly their reasoning powers, and their ability to discriminate between good and bad in architecture and to express themselves clearly in words.

Each year the question returns as to the best way of producing the Year Book of the Architectural Society. There are many objections to the present methods of conducting it. The value of the work as an advertisement of the Department has been so well proved that it is earnestly hoped the Executive Committee may see fit to put the publication on a permanent footing, and to give it the indorsement of the Institute.

Last year the Department was enabled to offer a travelling scholarship amounting to twelve hundred dollars, the very generous gift of a friend. Nine competitors, representing present and former architectural students of the Institute, met in the Department, where their drawings were made *en loge*, without any assistance after the start. The competition was very successful, and the prize was won by M. H. Whitehouse. Miss Ida A. Ryan and L. C. Clarke, Jr., received honorable mention. Mr. Whitehouse is at present studying in Italy. It is to be regretted that the opportunity the Department has to offer such a prize is the exception, and not the rule.

The Rotch Prize of two hundred dollars for the regular student making the best record during the four years was divided

equally between A. A. Blodgett and J. T. Wrinkle; and the prize of two hundred dollars for the special student doing the best work during two years was divided equally between F. C. Lebenbaum and R. G. Stebbins.

The two prizes of fifty dollars each, given by the Boston Society of Architects, were won by J. T. Wrinkle, regular, and W. Rasmussen, special student.

The two prizes of ten dollars each, the "Class of 1904 Competition Prize," were won by W. Soule, regular, and W. Rasmussen, special student.

It is a renewed satisfaction to note the continuance of good graduate work this year. There are eight candidates for the advanced degree.

FRANCIS W. CHANDLER.

DEPARTMENTS OF CHEMISTRY AND CHEMICAL ENGINEERING.

The past year has been one in which plans previously formulated for the improvement of the courses of instruction have been developed rather than a period marked by innovations. The changes outlined in the Report of last year in the Course in Chemical Engineering have attracted to that Course a fair proportion of the first-year class, and the number of graduate students from other colleges entering the Course has been gratifyingly large. The present fourth-year class is the last to graduate under the former schedule.

The third and fourth years of the Course in Chemistry have been so modified as to incorporate into them the changes previously adopted in certain chemical subjects in the Course in Chemical Engineering, including the transfer of the entire instruction in Industrial Chemistry from the third to the fourth year, and the beginning of the instruction in Organic Chemistry, both lectures and laboratory practice, at the middle of the third year. The instruction in Theoretical Chemistry has been condensed from three terms to two, and is now taken

in the third year. For the former lecture system there has been substituted one consisting of recitations, in which the subject is developed largely through the solution of problems involving fundamental principles. The time allowed for the laboratory work, which closely follows that of the class-room, has been increased so as to permit each student to devote to it one full day every other week throughout the year, and supplements the entire course. It is now true that in every branch of chemical instruction throughout the Department the work of the lecture or recitation room is correlated with laboratory practice, in which the student has opportunity to apply the most important of the principles discussed in conference, and to acquire some knowledge of the technique of the fundamental branches of his profession. Such an arrangement of work has long prevailed in a majority of the subjects taught, and its extension to the remainder gives promise of increased efficiency.

These modifications of the courses have largely increased the amount of instruction to be given in the Laboratory of Theoretical Chemistry, and have made necessary the appointment of an additional instructor in this subject. The number of students to be taught in the Laboratory of Organic Chemistry has also nearly doubled, and this has necessitated the appointment of an additional laboratory assistant and the utilization of a portion of one of the laboratories of Analytical Chemistry for organic chemical work. The need of enlarged accommodations for this work is urgently felt this year, and is likely to continue in the future, unless relief can be found.

The transfer of subjects within the courses has, on the other hand, occasioned a material reduction in the number of students in Industrial Chemistry for the present year, and the omission of the course in optical analysis of sugars, starches, etc. Professor Thorp will take charge of one of the laboratories of Analytical Chemistry, and Mr. Rolfe will assist in the first-year instruction for the present year.

The third of the biennial Summer Courses in Industrial Chemistry began at the close of the last Institute year, continuing from June 6 to June 22. It was, as formerly, under the direction of Professor Thorp, who, with Professor Talbot, accompanied the party of ten students from the third year of the Courses in Chemistry and Chemical Engineering. Besides the visits to the establishments named below, the course included the regular evening conferences conducted by Professor Thorp, at which the notes of the day were carefully reviewed and amplified after general discussion, and assignments were made to individual students of particular portions of plants or processes to be later inspected. In all, twenty-three plants were visited, as follows: Standard Sugar Refining Company, Boston; B. P. Clapp Ammonia Company, Pawtucket, R.I.; T. P. Shephard and Company, Providence, R.I.; Central Stamping Company, Newark, N.J.; American Smelting and Refining Company, Perth Amboy, N.J.; Alexander Young Company, J. T. Lewis and Brothers Company, Remmey Sons Company, Atlantic Refining Company, Burke Brothers, Dill and Collins Company, and the Point Breeze Works of the United Gas Improvement Company, all of Philadelphia; The Welsbach Light Company, Gloucester City, N.J.; Joseph Campbell Company, Camden, N.J.; Whitall Tatum Company, Millville, N.J.; Joseph Bancroft & Sons Company, Wilmington, Del.; Christopher Lipps Company, Baugh and Sons Company, D. F. Haynes and Son, Carr-Lowry Company, Sharpe and Dohme, and Fred Bauernschmidt, all of Baltimore, Md.; and the Maryland Steel Company, Sparrows Point, Md.

That the trip was a marked success was largely due to the many courtesies extended to the party by the managers of these various establishments, and by a number of our graduates. No effort was spared to make the visits profitable to our students, and in several instances the inspection of a plant was preceded by a talk descriptive of the processes involved, given by some one capable of speaking with author-

ity. The party was also delightfully entertained at luncheon by the Joseph Campbell Company, The Welsbach Light Company, The Atlantic Refining Company, The Whitall Tatum Company, and the Maryland Steel Company, and the favors extended, involving as they inevitably do a certain interruption of business in each establishment visited, should be, and are, cordially appreciated by the Department.

Within the past five years the Institute has found it possible to encourage research in Physical Chemistry by the establishment of the well-equipped Laboratory of Physical-chemical Research, under the direction of Professor Noyes, and to recognize organic chemical research by the establishment of an assistant professorship in that field. The advisability of the inauguration of a corps of research workers in Technical Chemistry has also been under discussion in the Department for some time. The problems in this branch of chemical science are not less numerous than in the more abstract fields, and there is a pressing need and a wide opportunity for investigation work of a high grade which would be of material service to the chemical industries of the country.

As a result of the course changes already referred to, certain funds are temporarily released for the present year, which make possible the employment of two research assistants in technical chemistry, who were appointed early in the summer and began work in August under the direction of Professor Walker. The problem upon which they are at present engaged —a study of the influence of the constituents of iron and steel on its corrosion—is one of importance to all chemical interests, and serves well as a type of the class of problems with which such a corps of workers might properly attempt to deal in a laboratory suitably equipped and endowed, and under a capable director. It is the hope of the Department that funds may be found for the continuation and development of this feature of our work beyond the present year. It is as yet too early to formulate extensive plans for the future, but it does not seem too much to say that the experiment of

the present year may well grow into one of the most important departments of the Institute.

The Department has also received during the year, through the generosity of Mr. Arthur D. Little, funds for the temporary maintenance of a research assistantship in Organic Chemistry, the subject of the research to relate to the chemistry of cellulose. An appointment will be made as soon as a suitably equipped assistant can be found. This gift is specially significant because of the purpose which underlies it; namely, to promote the interests and progress of a particular line of industry by the endowment of research in a field of pure science upon which the industry depends. The results hoped for are twofold: first, contributions to the scientific knowledge of the subject, which, however, under the best of conditions may be uncertain of attainment; and, second, the development of a young man who will be well versed in the existing Chemistry relating to the industry in question, and therefore in a position to serve it with unusual intelligence if transferred to the technical field. Such endowed assistantships have been established at other institutions, but this is the first in the Department. It is hoped that it may serve to attract others, to the advantage of both the industries and the Institute.

As a further indication of an encouraging spirit of co-operation on the part of the chemical industries with the educational institutions, there should be noted an invitation extended to the Department by Messrs. Harrison Brothers and Company of Philadelphia to nominate one capable student each year to enter a summer course of Applied Chemistry which they have just established at their extensive works. The course is expected to extend through a portion of three summers, and a certificate will attest its successful completion. The opportunity is apparently an unusual one, and Mr. Howard E. Batsford of the Course in Chemical Engineering, who spent a portion of the past summer in attendance on this course, found the experience highly profitable. It is to be hoped that other concerns

in other branches of Chemistry may find it possible to admit students who are recommended as responsible to similar privileges. Such a procedure could hardly fail to result in greater efficiency on the part of the graduate, and in benefit to both the industrial and the educational interests.

The Department has received gifts during the year of a valuable set of samples of chemicals, together with a suitable case for their exhibition, from the General Chemical Company, and another set of samples from the Picher Lead Company. The equipment of the Laboratory of Technical Analysis has been increased by a complete outfit for the determination of tannin, and two valuable sets of pigments, gums, and oils from the John W. Masury Company of Cleveland. These sets of samples are all of great value in connection with our instruction, and the increasing number of such contributions emphasizes anew the need of a separate room for museum purposes.

The year has been one of progress and general prosperity, but visits recently made to the laboratories of other institutions bring out clearly the great desirability of closer association of the branches of the Department than is now possible, and the loss of common interest that the present distribution of the work among the separate buildings entails. Previous reports have emphasized this departmental need, and also that of more small laboratories for research and for specialized lines of work, but the urgency of these needs justifies their reiteration here.

H. P. TALBOT.

RESEARCH LABORATORY OF PHYSICAL CHEMISTRY.

The Research Laboratory has this year a staff of seven research associates and three research assistants, who are devoting themselves exclusively to research work. In addition, five graduate students are pursuing work for the Ph.D. degree and one for the S.M. degree. Some of these candidates, as well as three others who completed their experimental work

last year, will apply for the examination for the Ph.D. degree at the end of the present school year.

Four seminars, attended by the advanced students, the research workers, and instructors from other Departments, are being carried on in the Laboratory by Professor Noyes, Dr. Lewis, and Mr. Kraus. These are devoted to a discussion of Mathematics as applied to Physical Chemistry, of the physical properties of chemical substances, of radioactivity, and of current researches.

A series of twelve articles on the electrical conductivity of aqueous solutions, describing the investigations on this subject made during the last three years in the Laboratory, is in process of publication by the Carnegie Institution at Washington. A large part of a revised scheme of qualitative analysis for the common elements, which has been worked out during the past year by Professor A. A. Noyes and Dr. W. C. Bray, has just appeared in the September number of the *Technology Quarterly*. A number of articles have also been published by Dr. G. N. Lewis on the equilibrium and free energy of some especially important inorganic chemical reactions.

Upon the financial side the Laboratory has been again assisted by a grant of $1,000 from the William E. Hale Research Fund and by a renewal of the grant of $2,000 from the Carnegie Institution to Professor A. A. Noyes in aid of certain electrochemical investigations which are being carried on in the Laboratory. In addition, a grant of three hundred dollars has been made to one of the research workers, Mr. Richard C. Tolman, from the C. M. Warren Fund of the American Academy of Arts and Sciences, to enable him to construct what will probably be the most powerful centrifugal machine ever made for experimental purposes, to be used in connection with an investigation of the electromotive force produced at the two ends of a rapidly rotating solution of any ionized substance; and a separate grant of three hundred dollars from the Rumford Fund of the American Academy has been made to Professor A. A. Noyes, which is to be used for the construction of a

calorimeter adapted to direct thermochemical measurements with solutions at 100°. A gift has also been made to the Laboratory of a large diamond, valued at about three hundred and fifty dollars, by the Ansonia Brass and Copper Company. This is to be used in insulating the electrodes within the bomb used in the conductivity investigations of aqueous solutions at high temperatures. Finally, grateful acknowledgment should be made of the assistance rendered by Dr. W. D. Coolidge, now in the Research Laboratory of the General Electric Company, in connection with the development of the apparatus for the investigation of the properties of water and aqueous solutions in the neighborhood of the critical temperature.

The general equipment of the Laboratory has been increased by the installation of a sixty-cell storage battery for furnishing a constant electromotive force for experimental purposes and providing night power during the summer.

ARTHUR A. NOYES.

DEPARTMENT OF ELECTRICAL ENGINEERING.

The changes in the instructing staff are indicated in the appointments of Professors D. C. Jackson and G. C. Shaad, the former of whom comes in February, 1907, to be head of the Department, and in the resignation of Professor Puffer.

Professor Puffer graduated from the Institute in 1884, and has served as one of the corps of instructors continuously since that time. Much of the early successful development of the Dynamo Electric Laboratory was due to his initiative and devotion, and for the original layout of the new Augustus Lowell Laboratory he was largely responsible. His engineering experience has been broad and valuable and of real service in the work of instruction. He retires from the Institute in order to devote himself wholly to the practice of his profession.

Professor Jackson comes to us as an engineer of standing and with the prestige of having developed a successful department at the University of Wisconsin.

Professor Shaad is a graduate of Pennsylvania State College in the class of 1900. After spending two years at the works of the General Electric Company at Schenectady, he was called to the University of Wisconsin, where he has since been one of the staff of the Department of Electrical Engineering. He has already entered upon his duties here as Assistant Professor of Electrical Engineering, taking up the work formerly given by Professor Puffer.

The system of instruction which has been recently developed in the Dynamo Electric Laboratory, involving a preliminary report, the performing of the particular experiment, the presentation of a final report, and recitations upon the principles involved, together with their engineering applications, must be influenced in the degree of success attained by the character of the laboratory assistants. These assistants remain at the Institute as a rule not longer than one or two years, being drawn to enter engineering practice by the more immediate and certain recognition which such practice offers. While at the Institute, they are as a rule overworked, the routine of examination of problems, the keeping of apparatus in such condition that it may be used at its highest efficiency, with the actual work of instruction, occupying their entire time. It is regrettable that the Institute cannot hold out to such of these men as show exceptional capacity inducements in salary and rapidity of advancement which will permanently enlist their services, to the end that there may be in the laboratory a body of instructors possessing experience, in addition to enthusiasm.

At the present time none of the work given in the Department to students of Electrical Engineering is in the nature of a purely lecture course. Indeed, the amount of recitation work is being considerably increased from year to year, and these recitations are conducted by the Faculty members of the staff. This last is a point of great importance, since too often such work is intrusted to the young and inexperienced instructor. The system of recitations might well be extended to include students in other Courses taking work in this Department, although

such an extension would naturally necessitate an increase in the number of instructors.

The plan of having many of the problems formerly assigned as home work now solved under the supervision of an instructor is being gradually enlarged with most satisfactory results. The opportunity for helpful suggestions and the elimination of harmful student co-operation are both accomplishments of geniune importance in the proper training of the students.

A plan which has been under consideration for two years past is this year put into effect, namely, the preparation of the preliminary laboratory reports under direct departmental supervision, instead of at home as formerly. This has resulted in a marked improvement in the character of the reports in arrangement, conciseness, and clearness. It has done away with hasty preparation and undue collaboration.

The scope of the Journal Meetings has been extended, and a greater amount of time is now devoted to this feature, as well as to the excursions to engineering plants in Boston and vicinity.

The members of the Department are particularly generous in the granting of time for individual conference with students. In fact the tutorial system, which has been introduced at Princeton University, has been practically in operation in this Department during the past two years. The effect of this more intimate contact of student and instructor is shown in the marked improvement in the student attitude towards the regular work. Taken in conjunction with the present curriculum, it gives the students a valuable engineering perspective.

The special appropriation granted by the Executive Committee has been expended largely for alternating current machinery and measuring instruments. This has put the laboratory on a sound basis so far as this particular line of instruction is concerned. There should still be, however, a considerable supplement to the direct current apparatus, in view of the unusually large number of students in the junior year of this Department (an increase of 20 per cent. compared with a year ago) and the desirability of giving a systematic course

of instruction in the laboratory for students in non-electrical engineering departments. This last cannot properly be carried on with the present equipment.

The installation of distributing centres in the Dynamo Electric Laboratory during the past summer makes possible an improved arrangement of apparatus and tends to increased efficiency in its use. This result is also distinctly helped by the enlargement and rearrangement of the instrument room. The variation in voltage on both direct and alternating current service is a serious drawback to the highest grade of laboratory work, and it is a satisfaction to announce that in the immediate future a Tirrill regulator is to be installed for regulation of the alternating current voltage. For the most satisfactory direct current service one of the Westinghouse three-wire generator sets should be placed under the immediate control of this Department, and this with the proper regulator would insure constancy of the direct current voltage. This voltage fluctuation has not only influenced the character of the regular laboratory work, but seriously interfered with the work of investigation.

In the Standardizing Laboratory the past year has resulted in a general development of the apparatus and the bringing of it to a higher state of efficiency. The publication of a pamphlet of eighty-six pages of laboratory notes has aided the systematization of the work. It is to be remarked that these notes have been planned to give general discussions of the various topics treated rather than specific directions for performing the experiments.

The demands on the laboratory for assistance in carrying out the various pieces of thesis work have continued, and, as in the past, the laboratory has proved of service to other departments of the Institute. During the year the development has been much facilitated by the employment of an additional assistant, who devotes his entire time to this special work.

A room has been set apart as a high potential laboratory and is devoted at present to the study of insulation and insulat-

ing materials. The equipment includes a 15 K.W. transformer giving 100,000 volts, together with the necessary controlling and safety devices; apparatus for testing samples of insulating material both for dielectric strength and insulation resistance; and for testing insulation of cables at various temperatures. Various measuring devices which experience has shown to be necessary are in process of development.

The division of Room 28 so that a portion is given to the assistants for office room is a distinct improvement, and adds notably to their comfort and to the efficiency with which their work may be carried on. The other horn of the dilemma is an insufficient office accommodation for the Faculty members of the Department. The lack of proper recitation-rooms still continues. It is frequently desirable to arrange a meeting for ten or twenty students at some time other than at one of the regular scheduled exercises, and this cannot be successfully carried out for want of a suitable room. More important still is the frequent impossibility of securing a proper room for the giving of experimental illustration in the regular lectures. The Lowell Building is being used more and more for work in other departments than Modern Languages, Chemistry, and Electrical Engineering. This encroachment is a serious drawback to the proper carrying out of the work of this Department.

The need of a storage battery is still felt. During the past year certain work of investigation has been given up from the lack of facilities which this particular apparatus would insure.

There have been various gifts of apparatus and samples of manufactured products by the electrical manufacturing companies. If these gifts could be properly arranged in a suitable room, they would prove especially helpful to the students in connection with their engineering work.

The annual excursion of the senior students last March largely exceeded in numbers and in interest any of those which have preceded it. This excursion in the senior year is most helpful, coming as it does when the students are keen to ap-

preciate the engineering importance as well as the scientific principles of the various types of apparatus and their commercial use.

H. E. CLIFFORD.

DEPARTMENT OF BIOLOGY.

A small but gratifying increase in the number of students is the most interesting feature of the opening of the new year. Particularly noteworthy is the increase in the number of graduate and undergraduate students devoting themselves to public health subjects or to the biological side of Sanitary Engineering. Recent developments in public, and especially municipal, sanitation show that the Institute has made no mistake in fostering studies and equipping young men for practical work in these directions, for an examination of the positions held by our graduates and other former students of Biology and Sanitary Engineering reveals the fact that some of the most important positions, and many of those having to do with the newer developments of water purification and sewage disposal, are held by our men.

In the hope of saving, if possible, the subjects of Physiology and Hygiene in the secondary schools, from which they have nearly been driven out, largely, as it is thought, by the misdirected zeal of those who have sought to use them as a means of promoting the so-called "temperance-physiology" movement, Professor Sedgwick and Professor Hough (the latter now Head of the Department of Biology in Simmons College and Professor-elect of Physiology in the University of Virginia, but for ten years and until lately attached to the staff of the Biological Department of the Institute) have for several years devoted some of their vacation time to the preparation of a text-book, which, while telling the truth about alcohol, should still be a rational and thoroughly scientific guide to the conduct of the physical life. This volume has lately been issued, and is believed by the authors to constitute an important contribution both to

general education and to the hygienic and sanitary information of the general public.

In July Professor Sedgwick was called to the Pacific coast to deal with a novel problem in municipal sanitation, namely, the question of the possible pollution of the public water supply of the city of Seattle by the construction, maintenance, and operation of a transcontinental line of railway which, in seeking entrance to the city, purposes to run for eleven miles alongside a mountain stream used, without purification, as the city water supply. He was afterward appointed one of three Commissioners to pass upon the possibility of safeguarding this water supply, and the opportunity thus given for the study of a wholly new problem in public hygiene proved unusual and important. In recognition of the useful sanitary work of the officers, graduates, and former students of the Department, Professor Sedgwick was in January of the current year made president of the New England Water Works Association, an organization of more than six hundred members, most of whom are actually engaged in the maintenance and operation of water works in New England. A large number of these same former students and graduates united during the year in the preparation and publication of a handsome volume containing nineteen original papers upon biological subjects dedicated to the head of the Department, to whom also a complimentary dinner was given by them on June 14th, on the occasion of the presentation of this volume. Both volume and dinner were tendered in celebration of the twenty-fifth anniversary of Professor Sedgwick's taking the degree of Doctor of Philosophy at Johns Hopkins University. The recipient, to whom these events were a complete surprise, desires to place on record his high appreciation of both testimonials, and especially of the expressions of interest and attachment which accompanied them.

In connection with the meeting of the American Medical Association early in June, and again during that of the American Water Works Association early in July, an extensive exhibit was made of the methods and results of sanitary instruction and

investigation in the various Departments of the Institute. The labor of installing and supervising this exhibit fell chiefly upon Assistant Professor Winslow, to whom much credit is due for its marked success. The cost of the exhibit was met by the generous contributions of a number of friends of the Department whom the head of the Department would be glad to name if he felt free to do so, and to all of whom he desires to express his heartfelt thanks.

A number of special students working together in the Research Laboratory of the Department, under the direction of Assistant Professor Winslow, have accomplished an important and elaborate piece of original investigation on the systematic relations of the bacteria of the family Coccaceæ. This work has not only cleared up the relationship of this group of organisms (which, besides some occurring in air, earth, or sewage, includes forms ordinarily causing blood poisoning), but also opens up a promising method of approach to some of the fundamental problems of variation and heredity. Professor Winslow has also given this autumn for the first time a brief course of lectures in Industrial Hygiene to students in the Heating and Ventilation option of the Course in Mechanical Engineering. It is desirable that some such instruction in the laws of health and disease, particularly as these relate to the sanitary construction and operation of industrial establishments, should be attended by more of the students of the Institute, and the Biological Department is now prepared to give such courses adapted to the specific needs of any Department.

Assistant Professor Prescott was called upon during the summer by the Charles River Basin Commissioners to make an investigation of certain alleged unsanitary conditions existing in connection with the Stony Brook conduit. These investigations he has completed, and the results have been reported to the Commissioners. It is expected that his report may soon be made public. Professor Prescott's private laboratory (the Boston Bio-Chemical Laboratory) continues to be useful not

only to the public at large, but as a model and an example for our students of Industrial and Sanitary Biology.

Dr. Stiles, Instructor in Physiology and Personal Hygiene, gave an elective course of fifteen lectures on Personal Hygiene in the spring term, with an attendance of ten students, largely from the fourth year, and representing different departments. There can be no question of the usefulness of such a course to young men about to scatter to all parts of the globe, many of them to encounter in their professional work unsanitary conditions which may easily wreck their whole careers; and sooner or later I hope to see such lectures attended by all our more advanced workers.

The Sanitary Research Laboratory and Sewage Experiment Station, affiliated as it is with this Department, has constantly proved of the highest service to students of Biology, and it is greatly to be desired that it shall become a permanent part of the Institute equipment, since it furnishes facilities altogether unique and well-nigh indispensable for students of Sanitary Biology, Municipal Sanitation, and Sanitary Science, not to mention those in Sanitary Engineering and Sanitary Chemistry.

Evidence of the continued activity of the Department in research and publication will be found in the list of publications beyond.

W. T. SEDGWICK.

SANITARY RESEARCH LABORATORY AND SEWAGE EXPERIMENT STATION.

By the continued generosity of the donor, who still prefers to remain anonymous, and who has made a further contribution of five thousand dollars for the purpose, the work of the Sewage Experiment Station has been continued successfully, and it is believed usefully, along the lines laid down in previous years. The experiments carried out in 1903–05 indicated that the trickling filter would probably offer the most economical method of purifying the sewage of such a large city as Boston. A large

outdoor filter of this type was therefore built at considerable expense in the summer of 1905, and its working has been studied continuously since that time under varying conditions and in combination with various subsidiary treatments in septic tanks and sedimentation basins. A new method of gravity distribution has been devised for spreading the sewage over the surface of the filter, and an elaborate series of investigations is being carried out, with specially designed apparatus, on the comparative efficiency of various English and American types of trickling-filter distributors. Mr. Phelps has made a study of the use of chlorine and other disinfectants for the bacterial purification of trickling-filter effluents. His work is now in press, and promises important practical results.

The results of the 1903–05 experiments, together with an historical survey of the sewage problem, the development of the art of sewage treatment, and the present status of the problem in various countries, has been published by Professor Winslow and Mr. Phelps in an edition of eight thousand copies by the United States Geological Survey, as "Water-supply and Irrigation Paper No. 185." This report constitutes Volume II. of "Contributions from the Sanitary Research Laboratory and Sewage Experiment Station," and a collection of eleven original papers on sewage and water problems by Messrs. Sedgwick, Winslow, and Phelps has been reprinted as Volume III.

An important extension of the work of the Station has also been carried out under a co-operative arrangement with the Hydrographic Branch of the United States Geological Survey. Mr. Phelps has worked out the principles of a practical method for the economical treatment of the waste from strawboard (paper) mills, and is now studying the problem of the utilization of sulphite (wood) pulp liquors. He is also carrying out investigations on the sewage pollution of Chesapeake Bay in relation to the oyster industry, and on the disinfection of the effluents from certain sewage plants in New Jersey. Professor Winslow is engaged in a study of the bacterial flora of normal waters in various parts of the country, in connection,

like the above-mentioned investigations, with the work of the Geological Survey, and also on an investigation of the micro-organisms in sewer air for a committee of the National Plumbers' Association.

We are now confronted, however, with the fact that our present facilities are both temporary and limited. We are wholly dependent on the financial support of our anonymous donor, who, single-handed, is supporting our work by annual donations with no promise of permanency. Our buildings—converted to our uses from an old livery stable—are of wood, and rapidly falling into decay. Our location, though central and convenient, has certain disadvantages of which we are frequently reminded. We need a better situation, more remote and carefully selected, but our first and greatest need is for suitable buildings. If in the past we have achieved some degree of success, it has been only at the expense of much anxious thought and effort to get along with what facilities we have had. As the work has become more advanced and specialized year by year, the inadequacy of the present equipment has become more and more apparent.

We may, it is true, continue where and as we are for many years to come, offering to students an opportunity for elementary research and contributing somewhat to the advancement of knowledge in sanitation; but, if we are to maintain the course which we have hitherto followed, keeping abreast of the best work in all countries and oft-times leading in new lines of development, an entirely new equipment is essential. Instead of the present converted stable we need a new filter-house, preferably of concrete or brick, with concrete tanks for experiments upon the treatment of sewage along the present lines. In addition, we need proper equipment for the thorough study of sewage hydraulics, flow and discharge measurements, sedimentation, and many other sanitary engineering features which we are now unable to investigate, and which, so far as I am aware, are not now subjects of practical investigation in any engineering school.

The same may be said of the pumping of sewage, and its control by gates and automatic discharge regulators, and of the pumping, pressing, and handling of sludge. These matters are of the utmost importance to every sewage disposal works; they are totally separate and distinct from the corresponding subjects relating to the treatment of water; and they should all be subjects of actual demonstration, experiment, and investigation in a properly equipped sewage experiment station.

In addition to these things we should possess a collection of all kinds of machinery and devices for the handling of sewage, such as gates of various types, sluice-gates, tide-water gates, screens, catch basins, etc., and working drawings of the best examples of pumping machinery and the more elaborate elements of a complete sewerage system. We might also to good advantage add to all this examples of modern plumbing, including sink traps, grease traps, and vents. Professor Winslow is now planning what promises to be a valuable study of the germ contents of "sewer gas." Such investigations as this are well within our field, and the testing of improved plumbing devices is certainly a matter worthy of our attention.

"Unique" seems to be the best term to apply to the whole project, and the Institute from its inception has always been noted for this characteristic. Engineering and other schools, some of them with great resources, are in many parts of the country following the lead of the Institute and equipping and maintaining laboratories of mechanical, electrical, and hydraulic engineering which rival our own great and costly laboratories in these departments. But a sewage experiment station and a practical sewage laboratory, equipped with the best of everything in which the sewage expert is interested, with facilities for mechanical, hydraulic, chemical, and bacteriological investigations going on side by side, and with a working exhibit of sewage-handling machinery, plumbing, gas and water fitting, and possibly, in the future, of ventilating devices and working models of garbage incinerators and smoke consumers,—all this would certainly make a station unique the

world over, and would put us well in advance in the teaching of sanitary science.

The cost of installing such a plant would be considerable, but the cost of maintenance need not necessarily exceed our present annual sum of $5,000, although much more could be spent to advantage.

We desire once more to express publicly to the donor our gratitude for the opportunities afforded to numerous investigators and students by the continued existence of the Sanitary Research Laboratory and Sewage Experiment Station.

W. T. SEDGWICK, *Director.*

DEPARTMENT OF PHYSICS.

There have been during the past year no material changes in the work of this Department which call for special mention. There has been a gradual increase in the amount of special instruction given in the laboratories, and it is believed that the grade of the work done in all the courses of instruction has been bettered.

An improvement was manifested in the results of the last entrance examinations in Elementary Physics. But few schools are still unable to give preparation in laboratory work, only a single school among those sending many pupils to us being in this category. It is hoped that it may shortly be possible to make the requirement in this subject an absolute one.

Difficulty has been and is still experienced in both lecture-rooms and laboratories from lack of sufficient accommodation for the large classes which we have to care for. In the lectures upon Heat in the present third year the number of students registered was larger than could be seated in the lecture-room, so great was the unexpected influx of students from other colleges entering in advance.

The extensive repairs made during the past summer will make the work of the coming year in many respects easier, and

the provision of more abundant case-room for our apparatus makes it possible to give more adequate care to its preservation in good order.

Much new apparatus of a general character has been added by purchase.

Also the Department has received a gift of a tuning-fork chronograph from Mr. R. F. Gaylord of Newton Centre. This instrument is of wide range, and is especially adapted to the accurate measurement of very short intervals of time. A complete quadruplex telegraph has likewise been presented to us.

The equipment of apparatus in the Laboratory of General Physics has been increased in the direction of our established policy of providing the best and most modern apparatus for the use of students. Among the larger accessions may be mentioned a new combination comparator and dividing engine made by Gaertner, with accessories for graduating circles, and a new standard photometer from Hartmann and Braun, with complete accessories for testing gas, incandescent, and arc lights.

As a result of the introduction of class-room instruction in the Precision of Measurements in connection with the laboratory work, referred to in the last President's Report, it has been found possible very materially to raise the standard of this work as regards the interpretation and discussion of results. The importance attached to this at the Institute seems to be unusual, judging from the laboratory records submitted by graduate students entering from other colleges; for it is only in exceptional cases that anything approximating the equivalent of the grade of work required of our students is presented. The interest which the students take in matters pertaining to abbreviated methods of computation, etc., is attested by the large attendance at Professor's Derr's elective course on Calculating Machines.

It has been found practicable to institute another change during the past year to the distinct advantage of the students in the Courses in Chemistry, Electrical Engineering, and Physics,

and that is to arrange their laboratory work in Heat in the third year concurrently with the lectures on that subject. It is hoped that a like change may be made in the schedules of other Courses.

In the Electrochemical Laboratory it has not been found necessary to make any large additions to the already existing plant. The students' equipment for electrochemical measurements has been increased, however, by the importation of a number of fine Hartmann and Braun resistance boxes, so that now each student is provided with his own. It is a matter of congratulation, in view of the very high price of platinum now existing, that sufficient platinum apparatus for all immediate needs of the laboratory was provided at the time of the establishment of the laboratory.

One of the research rooms has also been fitted with a thermostat and standard apparatus for the measurement of electrical conductivity of solutions and voltaic potentials, in order to facilitate investigations involving the measurement of these quantities. Among investigations completed or at present in progress may be mentioned the following, carried on by Professor Goodwin and Dr. Thompson: the free energy of hydriodic acid, the electromotive force of voltaic cells composed of fused salts, the melting point of refractory oxides, and investigation on "dropping electrodes."

For the Electrical Laboratory there has been purchased a large influence machine for the study of cathode rays and the use of Braun's tube.

To the equipment of the Optical Laboratory several important instruments have been added, the chief of which is a complete apparatus for microscopic photography, from the Zeiss Company, including objectives and eye-pieces of the best quality, giving an outfit suitable for photo-micrographic work of the highest grade. There will shortly arrive from the same makers their new apparatus for micro-photography by the use of ultra-violet light with which such surprising results have been obtained in the study of extremely minute objects. A

portable D'Arsonval galvanometer, a Hefner standard lamp, and several incandescent lamps of the newer types have also been procured.

For the Laboratory of Heat Measurements a special appropriation was made a year since. Much of this has been expended in the purchase of thermometers, pyrometers, including a recording pyrometer, platinum utensils, electric motors and rheostats, and for the construction of various instruments.

The equipment of the laboratory in apparatus for the measurement of very high and very low temperatures is exceptionally complete. For use in connection with precise thermometry at ordinary temperatures a standard gas thermometer is now under construction. For the determination of the heat of combustion of liquid, gaseous, and solid fuels the laboratory contains all the usual standard apparatus and much special apparatus as well. Several steel combustion bombs which are now approaching completion will furnish ample facilities to the students making tests of fuel in connection with research and thesis work, without interfering with regular class work.

An apparatus for the measurement on a large scale of the thermal conductivity of insulating materials, such as firebrick walls for boiler settings, etc., has been completed during the last term. This is to a great degree the result of thesis work of the students.

Apparatus for the production of liquid hydrogen is under way. In view of the large quantities of liquid air which are available from the Department of Mechanical Engineering, it is hoped that, when completed, it may prove very useful.

CHARLES R. CROSS.

DEPARTMENT OF GEOLOGY.

In 1906–07 the revised geological requirements of the mining schedule first take full effect. Instruction in field methods was this year given to thirty-three second-year and

thirty-four third-year students of Course III. Twenty-four fourth-year men are engaged in independent geological surveys. Of these thirteen are candidates for S.B. in the geological option of the mining Course, and one is a candidate in Course XII. The new microscopes of the petrographical laboratory are in use to the limit of their capacity, and two special students have been denied admission to the course in petrography because of lack of apparatus. The demand for men with practical training in the field and laboratory methods of topographer and geologist is constantly enforced by mining engineers, alumni of the school, and the students reflect this demand, showing keen interest and enthusiasm in their geological studies. In 1906 ten students of Course III. presented graduation theses in Geology. Two students are candidates for graduation in Course XII. in 1907. M. W. Hayward, S.B. (M. I. T. Course III., Option 1, 1906), holds an Austin Fellowship and is a candidate in Geology for a second bachelor's degree.

The total number of students enrolled in geological courses in 1892 was 290; in 1894, 367; in 1895, 399. Since 1900 the figures have been as follows:—

1900	439	1903	750
1901	501	1904	746
1902	598	1905	708
1906	823		

In 1906 there were more than three times as many students enrolled in geological courses as in 1890, when the Course in Geology was first established.

The development of Geology at the Institute shown by the foregoing statement has been occasioned principally by the service rendered to the Departments of Mining and Civil Engineering. Almost all students in Mining now receive instruction in Geology in their second, third, and fourth years; students in Civil Engineering receive such instruction in the second and third years. In these two Courses in 1905–06 were enrolled nearly half the regular students of the school for the three professional years. Furthermore, from one-third

to one-half of the graduating class in Mining now elects the geological Option and presents graduation theses in Geology. By direct comparison it is found that the total number of enrolments in geological studies (823) is not far short of the total in such elementary departments as Mathematics and Chemistry for all classes above the first year, and is greater than the total for the professional departments. It should be pointed out, therefore, that the limited space occupied by the Department of Geology (7 rooms) and the small size of the teaching force (7) are out of all proportion to those of other field and laboratory departments which give equivalent, or less, instruction, as measured in units of enrolment. Field work is believed to be the first essential of good teaching in Geology, and here the lack of experienced instructors is most pronounced. The advanced field courses are at present all guided by one professor, and it is impossible to give adequate personal attention to large classes working singly or in pairs over wide areas of rocky country. The professor's work is supplemented by that of one instructor and an assistant, who render efficient service. The nature of the subject, however, calls for extended professional experience. Three or more men of the grade of instructor might well be employed to give their whole time to the courses in Geological Surveying.

The rooms of the Department are now crowded to the limit of their capacity. The library contains three partitioned offices, desks for five officers, the book stacks and map cases, and the entire fossil collection, and is also used as a class-room. The geological lecture-room is in great demand for large classes other than Geology. In 1905–06 the requirements of of the tabular view at one time forced the course in General Geology to meet each week in three different rooms. The most pressing need is for space wherein the teachers of the Department may arrange their private collections, carry on research, and have a certain amount of privacy for their professional work. There is at present no place where this can be done. It is in the interest of the Institute that suitable laboratories be

provided for such advanced work, for in almost all cases the work may be shared by advanced students.

The opportunities for productive research in Physical Geology are nowhere greater than in a well-equipped technical school. The remarkable series of disasters in the last two decades due to earthquakes, flood-waves, and volcanoes marks the inadequacy and helplessness of earth science and its need of investigation on the practical side. The time is ripe for the establishment of research laboratories of Physical Geology devoted to experimentation and exploration-measurement of earth movements and prompt investigation in time of emergency with a view to forewarning and protection in the future. The engineering and physical laboratories can effectively co-operate in such investigations. Five thousand dollars a year for ten years at the Massachusetts Institute of Technology would establish and maintain such a laboratory, and in that time the published results ought to produce a permanent endowment. There is no field of science likely to yield a richer harvest of beneficent results. The Earthquake Investigation Committee of Japan has set an example which should be followed among all nations, and in this field alone there is an extraordinary opportunity for private endowment.

The work of Professor Crosby has been so arranged that his courses in Economic Geology are given on the intensive system; *i.e.*, in the last eight weeks of the first term and the first eight weeks of the second term. This works to the advantage of both professor and students. The former is at liberty to give a large amount of time to professional practice away from the school; and the latter are enabled to devote whole days to their Geological Surveying in the early autumn and late spring.

Professor Crosby is Consulting Geologist to the Board of Water Supply of New York City; and in that capacity he was able during the spring and early summer to make detailed geologic studies of several exceptionally interesting areas in the valley of the Hudson.

At the end of July, Professor Crosby went to Alaska and devoted two months to studying the ore-deposits and general economic Geology of Prince William Sound, Prince of Wales Island, and the Juneau District; and this was followed by six weeks of similar work in the Rocky Mountain region, including Montana, Idaho, and Utah.

All of this work has resulted in desirable additions to the economic geologic collections of the Institute; and a part of it will be published during the year.

Professor Warren, by resigning to Dr. Loughlin much of the instruction in Petrography, is able to give more time to Mineralogy. The class in Mineralogy for two years has been divided as follows:—

	Mining.	Chemistry.	Scattering.
1905–06	37	19	2
1906–07	40	12	2

It is to be regretted that students in Chemical Engineering, Course X., are not required to take Mineralogy. All students of Chemistry, moreover, would profit by a short course in General Geology. It is possible that such a course might profitably be introduced into the first year for a still larger group of students. Professor Warren, during the year, gave a course of fifteen lectures in Geometrical and Physical Crystallography for members of the Research Laboratory of Physical Chemistry. The mineral and rock collections have been much improved by additions, rearrangements, and by the preparation of new microscopic thin sections. Additions to the general laboratory equipment have been a Liebisch refractometer attachment to be used with the Fuess goniometer, for measuring the refractive indices of crystal plates; and a powerful electro-magnet designed by Professor Warren for use in studying the behavior of mineral grains in very intense magnetic fields. Professor Warren has developed a method for studying black sands and other rock powders in work done for the United States Geological Survey. This will be published, under the title "The Mineralogical Examination of

Sands," in the December number of the *Technology Quarterly*. A second article, which will appear in the *American Journal of Science* and the *Zeitschrift für Krystallographie*, describes a new mineral, Yttrocrasite, and is published in collaboration with Mr. W. E. Hidden. Professor Warren calls attention to a difficulty in the way of bringing to completion research in physical and chemical Mineralogy, in spite of the splendid facilities for such work which abound at the Institute. This difficulty is "lack of time, not arising from excessive hours of teaching, but from the fact that spare hours have of absolute necessity to be devoted, when the chance comes, to earning by any kind of professional drudgery enough money to make up the difference between the bare cost of living and an Institute salary." The writer believes this point is well taken, and that the junior professors and instructors at the Institute receive salaries incommensurate with their services. The mineralogical and petrographical laboratories are in great need of five hundred dollars wherewith to add to their equipment a large research microscope and a platinum resistance furnace for high temperature work.

To the Hon. George G. Crocker the Department is gratefully indebted for raising by subscription seven hundred dollars, of which five hundred dollars was used for an expedition in the far West and the remainder for the purchase of an apparatus for opaque projection. The subscribers other than Mr. Crocker were Messrs. Thomas L. Livermore, Charles A. Hopkins, Edgar Van Etten, James M. Prendergast, Galen L. Stone, and Dr. George G. Kennedy. Mr. W. F. Jones of the Class of 1909 has given the Department a valuable collection of fifteen hundred species of modern shells in a suitable walnut cabinet,—a useful adjunct to the fossil collections.

The expedition above referred to, planned and carried out in the summer of 1906 by Professor Johnson, received further support from the Austin Fund and from Harvard University. Special geologic and physiographic problems were investigated in the course of an extended wagon trip through New Mexico,

Arizona, and Utah. Dr. Shimer was a member of the party. Valuable collections were made, and a number of points of geologic interest discovered. Lantern slides of the characteristic topographic and geologic features of the region traversed will form an important addition to the teaching collections of the Department. A detailed report of the expedition will be found in the December number of the *Technology Quarterly*, while special reports on the various problems studied will be published later. While in the Southwest, Professor Johnson made an investigation of the underground water resources along a portion of the Atchison, Topeka, and Santa Fé Railway System, for which company he has acted as consulting geologist during the past year. He spent a portion of the mid-year vacation in New Brunswick, reporting on magnetite properties for a Canadian company. Before leaving for the summer, he completed the editing of a volume of geographical essays by Professor W. M. Davis, which will appear in book form in the near future. He has also been engaged in the revision of state articles (U.S.A.) for a forthcoming edition of the *Encyclopædia Britannica*. Last year Professor Johnson received a grant from the Austin Fund for work on drainage-modifications in northeastern Georgia. His report on this work, which is now in press, was awarded second prize in the Walker Memorial Prize Competition. The first prize was also awarded to an Institute man, a graduate and former teacher of the Department, Professor A. W. Grabau of Columbia University.

In June, 1906, Professor Jaggar resigned his position in Harvard University with a view to confining his teaching hereafter wholly to the Institute. This was made necessary in part by Dr. Johnson's appointment as Assistant Professor of Physiography at Harvard. Dr. Johnson gives up all connection with courses in Economic, Structural, and Field Geology at the Institute, while continuing to give instruction in Topographic Geology. Professor Jaggar completed during the year his share in the text and maps of the geologic folio of the Spearfish-Sturgis district of South Dakota. This is a

part of the Geologic Atlas of the United States, published by the United States Geological Survey. The work has occupied him for some years, and deals with the structural geology of the mining district of the northern Black Hills. In February, 1906, by invitation of the Education Committee of the Twentieth Century Club, he gave four public lectures in the Colonial Theatre, Boston, on "The Earth as a Living Organism." In April, on the occasion of the eruption of Vesuvius, he was granted leave of absence to visit the scene of the disaster and make notes and collections. This excursion was made possible by the generosity of Mr. Alexander Agassiz, who assumed the entire expense.

Dr. Shimer reports gifts of small collections of fossils from present or former students of the Institute. These were from Nova Scotia, Massachusetts, New York, North Dakota, and Arizona. In the Arizona-Utah expedition, Dr. Shimer secured valuable collections for his course on "Index Fossils," and also rock specimens, especially lava, photographs, and sketches which will be useful for the courses in Structural Geology and Lithology. In 1907 Dr. Shimer will have full charge of these courses, formerly given jointly with Professor Johnson. The course on Index Fossils has been expanded and is now required in the 3rd Option, Course III. The election of this work in Palæontology has shown a marked growth in the last four years, as follows:—

Number of Students taking Index Fossils.	
1902–03	3 (prescribed)
1903–04	4 (1 elective, 3 prescribed)
1904–05	4 (3 elective, 1 prescribed)
1905-06	8 (wholly elective)

The completion of Part I. of Grabau and Shimer's "Index Fossils of North America" gives to geologists the first instalment of a long-needed and very useful work, involving great labor on the part of the authors.

Dr. Gerald F. Loughlin returns this year to the Department to take charge of the elementary courses in Petrography and

Economic Geology. Dr. Loughlin in 1906 completed a thesis at Yale University entitled "Contribution to the Geology of Eastern Connecticut" for the degree of Doctor of Philosophy. With Professor Barrell of Yale he is writing a bulletin for the State Geological Survey of Connecticut on the type rocks of Connecticut. He spent the summer in gathering sets of rocks to be used for distribution among schools of the state. He has further accepted the position of reviewer of foreign bibliography for the journal *Economic Geology*.

A. K. Adams, Assistant in Geology in 1905–06, was called by the United States Geological Survey in the spring to assist Mr. Diller in southern Oregon. He has since been appointed Professor of Geology in the New Mexico School of Mines. F. R. Ingalsbe was to succeed him at the Institute, but he in turn received appointment as instructor in Lehigh University. W. G. de Steiguer of the same class has been appointed Assistant in Geology.

Miss M. Hodgkins, recently appointed Librarian of the Department of Geology, reports that there are over three thousand volumes in the Geological Library and one-third of these are in pamphlet form. Of the United States Geological Survey publications and various State Survey bulletins there are now three hundred unbound. Many of these are used very frequently, and are becoming mutilated and worn. New bookcases built during the past summer have made it possible to arrange the books on the shelves with space enough for the probable accessions of two or three years at least; the maps and charts, probably between one thousand and fifteen hundred in number, are being labelled for convenience in quick identification, and the book catalogue of maps is being transferred to a card system for greater convenience in use.

The need of a larger instructing force for the teaching of Field Geology has been mentioned above. Another need, of like importance, is for money to pay the expenses of instructors whereby they may conduct summer schools of Geology and Mineralogy. These should take the form of extended trips to

localities of interest to students of Mining. All the teachers of the Department are unanimous in the belief that summer expeditions are of the utmost importance to broaden the students' experience, open new lines of study and investigation, supply the laboratories with fresh material, and suggest thesis or research work. The expense of travel is so great that our students ought not to be required to pay fees in addition. If a few scholarships could be provided, it would be well to *require* a summer course of six weeks' duration for students of Geology or the geological option in Mining. A good camping outfit of tents, mess chests, stove, wagons, and stock, in some favorable locality of the West such as the Black Hills, would be an invaluable gift to the Department of Geology.

Two other extensions of our teaching are desirable,—both would be natural outgrowths of the proposed research laboratory of Physical Geology. A technical school should offer courses in Climatology and in Oceanography with special reference to their bearing on engineering. Both subjects are of importance to students of Civil and Sanitary Engineering and Naval Architecture, and are related to Geology, Chemistry, and Biology. No great expense would be necessary in order to establish such courses, and, even if they were made elective, there would be resort to them at present by special and five-year students.

T. A. JAGGAR, JR.

DEPARTMENT OF NAVAL ARCHITECTURE.

The regular Course in Naval Architecture this year has the advantage of changes which were rendered possible by advanced requirements for admission, which demand preparation both in French and in German. The additional time assigned to professional work was applied to strengthening instruction in Ship-construction and to increasing the time given to Ship-design. The number of lectures in Ship-construction has been doubled, and is distributed so as to co-ordinate with the Ship-

design. Also courses have been added in Ventilation and Drainage and in Applied Chemistry, the latter dealing with the chemical composition of certain materials which are used in ship-building, with the nature and causes of corrosion of framing and plating, and with methods for checking corrosion and fouling.

In connection with the development of the courses of lectures on Ship-construction a large number of valuable lantern slides has been made, and our collection will be increased as opportunity allows.

There is now in process of construction for the Department a series of wooden models of ship-framing that promise to be of great importance in teaching Ship-construction; some are already completed, and others will be made by the model-making instructor. The models are about a quarter size, are easily handled by the lecturer and by students, and show at a glance many things that must be described at length, and perhaps not quite understood until the student has opportunity to see such construction in ships.

The Course for Naval Constructors has now become well established. There have been but few recent changes, and those were made to take advantage of improvements in the Department of Electrical Engineering, and have made possible a better co-ordination of the theoretical and laboratory work in that important branch of the profession.

The advantage which students in the Department have realized from making models of ships of their own design has been so evident that a tentative effort will be made this year to include that subject in the list of required exercises, the time being taken from the assignment to Ship-design. When opportunity comes, the attention given to this subject will be increased. It has long been considered that this work could be made more efficient if it could be done in Engineering Building C, where it could be more directly under the supervision of the regular instructors of the Department, and where students could more readily use extra time if so disposed. For this purpose

some of the benches for model making will be brought to the drawing-room from the shop on Garrison Street, leaving the tools for preparing stock and the painting and varnishing at that location as heretofore.

Up to the present time the entire expense of equipping the model shop, of supplying material and furnishing instruction, has been met by a friend of the Department, and now it is desirable to consider the question of providing permanently for this work. Arrangements have been made for this present year only to take the entire time of the man who has given instruction in the model shop, for the eight months of the school year. In addition to the instruction of students he will be able to make some ship models desired for illustration, to finish others ready for placing on our walls, and to do other work for the Department.

Attention was called last year to certain glass-topped tables that were given to the Department just in time for the mould-loft work of 1905: these tables were thoroughly tested last June, and have fulfilled every expectation and are believed to be superior for our purposes to tables made in a similar manner of marble, and used both in this country and abroad. Nearly the whole of the present fourth-year class took our course of instruction in mould-loft work last June, and a large portion of them made a model in our model shop in the same month.

The attention of the Chief Constructor of the Navy having been called to our model work in 1903, he decided to order the constructors of the junior class to take instruction at the end of the year before taking up their summer excursions to steel works, electric works, etc.; afterwards by their own request the senior class of constructors have taken our instruction in mould-loft work, though the Bureau of Construction and Repair has abundant facility in the mould lofts of the Navy Yards for such work.

For two consecutive years, through the kindness of a friend of the Institute, lectures have been given every fortnight by eminent specialists in Naval Architecture, Shipbuilding, Marine

Engineering, and allied subjects, and this year an unusually interesting series of lectures has been arranged. Some of the lectures which are of more general interest will be given by speakers engaged for this course, before the Society of Arts, arrangements being made for students to hear the lectures.

Thus far attention has been directed to changes and improvements in matters that are considered to be practical, in contradistinction to the theoretical instruction of the Course. Such emphasis is natural at this time, because the means and opportunity for such improvements have come more recently. On the other hand the theoretical instruction has been in process of development for about fifteen years, and recent improvements are of the nature of increased efficiency due to increased experiences or by the better correlation of theoretical instruction and the application of principles thus taught as the practical side is developed and extended. This improvement, though no less solid, is less easily explained, if indeed it may not be left to be inferred for any live course of instruction.

Some years ago there was a sudden increase in shipbuilding activity in this country, with the expansion or new installation of shipyards, and with this a large demand for men properly educated in Naval Architecture. Though the Course in Naval Architecture had a large corresponding growth, practically all our graduates from that Department who desired had good opportunities in their profession. With the more recent stagnation in shipbuilding, many of these men have found better opportunities in general engineering, and in consequence of the active demand for graduates of engineering schools many of our recent graduates have passed at once on graduation into general engineering; and yet there have been from time to time numerous applications for men to take up work in shipbuilding or related industries, for which the Department frequently could not make provision. As the revival of shipbuilding has already begun, there seems to be no reason why students who desire to take the Course in Naval Architecture should hesitate to do so.

to Lorient, to Cherbourg, and back to Paris, where it has long been established. To this school must be given credit for much of the leading position of the French in both the theory and the practice of Naval Architecture. The students at the École d'Application du Génie Maritime come from the École Polytechnique, so that the course of study at these two schools may properly be treated as the complete course of education offered for naval constructors. Two years at the polytechnic school are given to general and fundamental training, and two years at the school of Naval Architecture are given to special work and to its application to shipbuilding.

Students are admitted to the École Polytechnique by competitive examination, held at various cities throughout the country, and open to all young men between the ages of sixteen and twenty. The applicants for examination are numerous, and the competition is close, so that the students admitted to that school are a select class. The examination includes Arithmetic, Geometry, Algebra, Trigonometry, Analytical Geometry, Descriptive Geometry, Physics, Chemistry, Drawing, French, and German.

A careful system of ranking is carried through the two years' course at the polytechnic school, and on graduation the students, to the number of about one hundred and twenty-five, are allowed to choose (in order of their rank) appointments in various branches of government employment open to them. The appointments in naval construction are taken by men near the head of the list, so that there is thus a double system of selection for the students in the school of naval construction.

The following is a brief synopsis of the course of study at the École Polytechnique:—

Mathematics: including Differential and Integral Calculus, Fourier's series, Laplace's functions, imaginary variables, elliptic functions, and Calculus of variations.

Mechanics: including kinematics, statics, dynamics, hydrostatics, hydrodynamics, thermodynamics, theory of elasticity, and hydraulics.

Descriptive Geometry: including shades and shadows, perspective and a general geometrical study of curves and surfaces.

Physics: including heat, thermodynamics, conductibility, elasticity and magnetism, acoustics, and light.

Chemistry: inorganic, organic, and technical.

Drawing: mechanical and freehand.

Architecture.

Topography and Military Art.

Literature.

History.

German.

No study of a synopsis of the course, whether of the brief one here given or of the very complete synopsis from which it was abstracted, can give an adequate conception of the work of the school. But there are a few conclusions that are inevitable; the course is intensely mathematical and theoretical, and no one who has not a decided natural bent for mathematics can hope to finish it. Information from those who have taken the course at the school for naval constructors is to the effect that the graduates from the polytechnic school have a grasp and a facility in the use of mathematics that few American technical students ever gain. This mathematical facility carries with it a preference for mathematical forms and a confidence in the results of the application of mathematical methods to practical operations that is reflected in all the French literature of Naval Architecture and shipbuilding.

The course of instruction at the École d'Application du Génie Maritime consists essentially of lectures and of drawing and design; there have recently been added shops for manual training. The regular regimen of the school is to give to each of the two classes a lecture every morning at half-past eight; the lecture usually lasts two hours, but can be extended to three hours at the discretion of the lecturer. It is the habit to cover a large amount of work in each lecture. An opportunity is given students to ask questions, and there is some attempt at quizzing students at the end of the lecture.

Every week there are formal quizzes at which marks are given, and which are very important in the determination of the rank of the student.

The afternoons are given to drawing and design, or to shop work. A large amount of attention is given to the student's *projet* or design of a ship and its machinery. The student is encouraged to consult frequently with the professors in connection with this work, but he can avoid such consultation if he desires, and professors are likely to leave such an one to his fate. From July first to September twentieth the students are required to inspect navy yards and engine works, and to keep a diary with sketches and descriptions, which are submitted at the end of September. At that time there are oral examinations on the whole work of the year before the professors of the school and other officials designated for that purpose.

A complete synopsis of the course of study at the school was given by the Director to the writer last June, together with certain lithograph notes of lectures and a printed work on the Théorie du Navie by Clauzel. From this material a very complete idea of the work covered by the lectures can be obtained. A brief abstract of the synopsis of the course follows:—

Brief Synopsis of the Course at the École d'Application du Génie Maritime.

Ship Construction: including materials and methods of construction, accommodations, and methods of launching; also statement of problem for design.

Theoretical Naval Architecture: including displacement, geometry of floating bodies, stability (both statical and dynamical), addition of weights, grounding, docking and launching, resistance and propulsion of ships, steering, waves and rolling.

Resistance of Materials: including tension, compression, shearing and bending, and the application of the theory of elasticity.

Steam Engines: parts of engines, operation of parts, condensers, propelling agents, statement of problem for design, theory of steam engines, steam turbines, erection of engines, and piping.

Steam Boilers: shell and tube boilers, installation and working of boilers.

Mechanism: sources of energy, thermodynamics, flow of fluids, losses of energy, centrifugal fans and pumps, injectors; fly wheels and governors; brakes and indicators.

Applied Electricity: general terms and definitions, continuous currents, dynamos and motors; accumulators, electric lighting and wiring; alternating currents, transformers, motors and distribution; wireless telegraphy.

Technology: production of heat, storage and use of fuels; materials for shipbuilding; equipment of yards and shops; management of yards and shops.

Naval Artillery: interior and exterior ballistics, armor plates, projectiles, gun-carriages, turrets; offensive and defensive power of ships; submarine boats and torpedoes.

Adjustment of Compasses: deviation, compensation, placing of compasses.

Administration and Accounts.

The complete synopsis from which the preceding abstract was made, and the lithographic and printed notes of lectures, give a good idea of the scope of the work of the course. At the time of my visit the designs of ships and engines made by the students were shown, and all questions concerning them were freely answered. A number of Americans in and out of the naval service have completed the course at this school, and among them are several personal friends, who have discussed the course and the methods of instruction very frankly with the writer; in particular, one of our alumni immediately after completing the course showed me his notes, and explained the methods of work very minutely. From all this information I am of the opinion that the entire course of four years in the École Polytechnique and the École d'Application du Génie Maritime gives a training that has no superior, and that the graduates are well versed in the theory of their profession and have as much knowledge of the practice as can be gained from two summers' inspection of navy yards. If there is any criticism of the course, it may be attributed to national characteristics, such as a tendency to try

to work out problems in a strictly logical method and to place an exaggerated importance on mathematical operations.

Systematic education of naval constructors for the British navy began in 1864 with the establishment of a course at South Kensington. In 1873 the course was altered and improved and transferred to Greenwich, where it became an integral part of the Royal Naval College, which gives higher education to various classes of officers of the British navy.

There are three methods by which entrance to the course in Naval Architecture at the Royal Naval College may be attained. A small number of students at the Royal Naval Engineering College at Keyham may be designated for instruction as naval constructors and given special opportunities to learn the practical side of shipbuilding; after four or five years at this college they proceed to the Royal Naval College at Greenwich. The British Admiralty has a system of shopwright apprenticeship at the Royal Dockyards to which youths are admitted between the ages of fourteen and sixteen. The regular apprenticeship is for a term of seven years, and during the first three years they are expected to attend dockyard evening schools; those showing ability in these schools may be granted permission to take a fourth year of such instruction. From the dockyard apprentices who have completed four years of their term a number are selected after examination for training as naval constructors; those selected have a year at the college at Keyham, and from there go to Greenwich. Since the college at Keyham is to be abandoned in consequence of the adoption of the new system of education of officers for the British navy, the first source of supply mentioned above from that college and the year's training for shipwright apprentices at that college are about to terminate; what will be substituted is not yet known.

The third method of entering the college at Greenwich is by examination, and in practice this is open to all British subjects, though the authorities have absolute control of selection. Formerly foreign students were admitted in this manner;

a number of American naval constructors took this course, all of whom took leading positions in their profession either in or out of the navy; at the present time a few Japanese students are taking the course, probably in consequence of the treaty between Great Britain and Japan. Such private students, if they show proper qualifications, may be transferred to the corps of naval constructors at the termination of their course. Though it has no direct connection with the subject, it is interesting to know that dockyards foremen who have not had the advantage of the course at Greenwich may be appointed naval constructors if they show proper qualifications, a fact which is an evidence of the essentially democratic spirit of British institutions in that they always leave open a door for advance to those who are able to take advantage of it. Private students on entrance are expected to present from some shipbuilding establishment with which they have been connected an introduction showing good character and some knowledge of the practice of shipbuilding. They must pass an examination in the elements of Calculus and Applied Mechanics and in Chemistry, Physics, and shipbuilding. As an added attraction there is a scholarship of £50 a year. The number of private students has always been small, even including foreign students. A reason offered for this condition of affairs is that the mathematical requirements both for admission and in the course are very severe; and, again, the position of assistant constructor with a salary of £200 a year is not sufficiently attractive to a person having the required mathematical attainments.

There are now four professors (of Mathematics, Applied Mechanics, Chemistry, and Physics) connected with this course at Greenwich, together with a lecturer on Naval Architecture who is a naval constructor connected with the Admiralty, an instructor in naval design, an instructor in marine engine design, and certain other instructors.

The course consists of three sessions of nine months, from October to June. During the summer months the government students are drafted into the dockyards, and private students are given facilities for visiting dockyards.

A very strong course is given in pure and applied Mathematics, including Analytical Mechanics. Three mornings a week are given to this subject throughout the course.

Parallel with this is a course in Applied Mechanics, including strength of materials, framed structures, kinematics and dynamics of machines, theory of elasticity, hydraulics, thermodynamics, and theory of the steam engine, theory of waves, and resistance and propulsion of ships. A laboratory of engineering and mechanics has recently been established, sufficient for the limited number of students and equipped for work of the highest character.

Lectures are given in Physics and Electricity, and a large amount of laboratory work is undertaken. In Chemistry the lectures and laboratory work are not specially advanced.

The senior instructor or lecturer in Naval Architecture visits the college two or three afternoons of the week and gives lectures and supervises the work of the students. The actual instruction is given by the junior instructor, who is in residence at the college, and who has control of the drawing and design of all three classes, numbering about ten in each class. The time assigned for this work is six hours per week the first year, nine the second year, and twelve the third year; students commonly spend more than the allotted time on their design. All the drawings are made on antiquarian paper, in great detail, with rather a liberal use of watercolor; the designs are ambitious, mostly battleships of the largest class; the quality of draughtsmanship is not exceptionally good.

The first year and about a third of the second year are given to preliminary training in ship drawing and calculation, such as fairing lines, calculation of displacement and stability, and the construction of curves of weight, buoyancy, shearing forces, and bending moments for a ship in still water and on a wave. This last work is done in the second year for a design in the hands of third-year students. The remaining time of the second year is given to a preliminary design of a warship, the students working in pairs to distribute the labor of calculation and drawing. This design is carried to completion in the third year.

The drawing and design of the first and second years are parallel with lectures given by the senior instructor on the subjects mentioned above, and in the third year there are lectures and calculations on such subjects as the geometry of floating bodies, grounding, docking, launching, effect of bilging, and dynamic stability. Lectures are also given on rolling in still water and among waves, dipping and pitching, method of observation, and graphic investigation of rolling.

Parallel with the ship design is work on drawing and designing engines; this branch naturally receives somewhat less attention, beginning with design of single parts and afterwards taking up the general design of engines. A good deal of time appears to be given to the drawing of details following current practices. Statical calculations for strength are made, and lectures are given in dynamical actions, including balancing.

At the time of my visit to Greenwich, Professor Ewing, the Director of Education to the Admiralty, gave me every opportunity to investigate their methods, and personally conducted me through the laboratories. Professor Henderson, in charge of the department of Applied Mechanics, discussed his methods and plans most frankly and showed me lecture notes. Mr. Smith, the junior instructor in charge of the naval design work, gave me every facility to see work in progress and to talk with students concerning their work; and like courtesy was shown by the instructor in marine engineering.

In the preparation of this report I have had the advantage further of a paper by E. L. Attwood, Esq., the senior instructor in Naval Architecture, on The Admiralty Course of Study for Training Naval Architects, read before the Institute of Naval Architects at their meeting in April of 1905. And further I have had a set of recent examination papers kindly furnished me by Professor Ewing. Since, according to the usual British custom, very great weight is given to the final examination, this set of papers gives an excellent idea of the scope and thoroughness of this course of training.

In all the reports and discussions of this course of study

emphasis has been given to the very high standard required in Mathematics; it has been said that this standard has had the effect of excluding or discouraging private students. Some of the graduates of the course have expressed the opinion that too much weight is given to Mathematics. It is perhaps no violation of confidence to say that the present Director of Education to the Admiralty has this question under consideration, and will correct any such tendency that he may conclude to exist.

It is very fortunate that the two leading schools of Naval Architecture, at Paris and at Greenwich, have always maintained a high standard of scientific training; as a consequence, trained naval architects have understood their profession, and it behooves any college offering education in this line to see that the real standard is not lowered. The mathematical attainments required for handling the theory of Naval Architecture are not more than any trained engineer should have. The real question to my mind is not so much the amount of time to be given to Mathematics and its applications as the attitude of mind of the teacher. At the time when the Royal Naval College was established mathematicians of high attainments and known repute were trained in the Universities, where the subject was used mainly as an instrument for educational training and where methods may be characterized as academic rather than practical. The traditions of such a school with its high reputation would naturally be conservative, and it is a fair question whether the same training and a better mastery of the instrument may not be had if the subject is treated rather from the side of the engineer and constructor.

The first course in Naval Architecture not under government control was established at the University of Glasgow in 1883. Unfortunately the exceptionally short term of this institution made it impossible for me to visit it while in session, and consequently my knowledge of the course is correspondingly imperfect, being derived from the University Calendar, from an article by Professor Jenkins in the "Transactions of the

Institution of Naval Architects" for 1889, and from reports from persons who studied at the University.

In order to understand the course of Naval Architecture and Marine Engineering, which is properly classed with the courses in engineering, it is necessary to know something of the Scottish Universities and of the methods by which young men in Great Britain gain entrance to the engineering profession. The Scottish Universities were founded in the Middle Ages, and have had an uninterrupted development along their own lines, with such changes as have been considered proper to fit them to modern conditions; in particular, attention was given at comparatively early times to the education of engineers. It is not necessary to dwell upon the reputation they have enjoyed for high scholarship and serious work.

In general, instruction has been given by lectures, and that method still has a preponderating influence. Together with such instruction by lecturers laboratory practice has been introduced in Chemistry and Physics and more recently in engineering; important engineering laboratories have recently been completed at the expense of £40,000. It is interesting to note in passing that "The laboratories are open daily; the hours of attendance are arranged with the individual students."

With the system of education mainly by lectures there is naturally given a wide discretion to students as to what work they shall undertake and how it shall be arranged. And, again, a larger weight is given to examinations, which are extensive and severe. It is, however, stated that "a candidate for the degree of Bachelor of Science shall not be deemed to have attended a class as part of the curriculum for that degree who does not present a certificate bearing not only that he has given regular attendance, but also that he has duly performed the work of the class."

In order to be admitted to a course leading to the degree of Bachelor of Science a student must pass a preliminary examination in English, Modern Languages, and Mathematics; the last subject must be of a higher standard than is in general re-

quired for students of arts. He must have been in residence at the University for three full academic years, except that permission may in some cases be granted to take some part of the work of the course at other Universities or institutions or with private teachers approved by the University; special privileges are granted for study at the Glasgow and West of Scotland Technical College. It is understood that this rule as applied to American students requires that in order to take the degree they must complete a full course of three years at the University, and that attendance is required at all classes in order to enter the corresponding examinations.

In order to qualify for examination as candidate for the degree of Bachelor of Science in engineering, the student must take nine full courses of study; there is provision for half courses in some subjects, two half courses being counted as a full course. The standard requirements for Naval Architecture and Marine Engineering are:—

1. Mathematics, including Analytical Geometry and Differential and Integral Calculus.
2. Natural Philosophy, including applied higher Mathematics.
3. Chemistry.
4. A course in physical laboratory or chemical laboratory.
5. } Two courses in Naval Architecture with Marine Engineering.
6. }
7. } Two courses of practical work in ship and engine drawing.
8. }

Students in engineering may elect to take one course in Naval Architecture without drawing; but under these conditions they cannot be considered properly to be students of Naval Architecture.

The degree of Doctor of Science may be granted to bachelors of the University after five years on presentation of a thesis or published memoir or work, provided that the candidate shall pass examinations if required.

In explanation of the list of subjects given above, it may be said that Natural Philosophy deals mainly with dynamics, treated

in such detail and with such reference to practical problems as may render it suitable for students of engineering. The calendar of the University gives examination papers for the year 1905, of which two in Natural Philosophy and one in higher Mathematics give questions in dynamics, hydrostatics, elasticity, heat, light, magnetism, electricity, harmonic variation, the catenary, projectiles, floating bodies, and thermodynamics. The examinations have each about fourteen questions, of which only nine need be answered, so that the student has a chance to select to some extent the material he will present for examination.

The laboratory course in Physics to accompany the second subject provides experiments in heat, light, and electricity.

The lectures in Naval Architecture and Marine Engineering are given three times a week throughout the yearly session for two years; and there are classes for drawing and design three hours on each of four days in the week. The calendar does not give an explicit statement of the course of study, nor have I an authoritative statement to present as in the case of the two governmental schools. The article quoted above, by Professor Jenkins (deceased), gives at great length the details of a course of instruction in Naval Architecture covering three years, and intended apparently to be equivalent to the course at Greenwich; a like statement by Professor Biles (the present incumbent) in 1891 has come to my hands through a private source; neither purports to be the course outlined in the calendar, which covers three years in all, only two being given to Naval Architecture; nor have I any information that such extensive courses have ever been given. Such information as I have been able to gain from our alumni who have been to Glasgow indicates that the instruction in Naval Architecture was at the time of their attendance in an advanced condition. All have been enthusiastic with regard to the head of the department, and regretted only that his private practice occasionally interfered with the regular progress of instruction. As Professor Biles has an international reputation and a wide professional practice, it would appear inevitable that such a difficulty might be expected to increase; I

have been informed that there is a growing dissatisfaction from that reason. In passing, the question may be raised whether an engineer who has a large private professional practice can give such time and thought to teaching as he himself would desire. Further, practical men have offered me the unsolicited opinion that the practice of engineering has the tendency to divert the mind from principles, which are the vital element of teaching, to details, which frequently are what determine success or failure in practice.

A further investigation of the calendar shows that students who are working for the bachelor's degree in engineering take, instead of the two courses (5) and (6) of the course in Naval Architecture as outlined above, two courses in engineering, including such subjects as surveying, strength and elasticity of materials, prime movers (steam engines, etc.), and hydraulics. The inference is that so much of any of these subjects as is given to students of Naval Architecture must be included in the two courses of lectures outlined above, and this inference is borne out by the large amount of attention which has been reported as given in those lectures to the question of strength. Undoubtedly there is advantage in the concentration of attention that may be given to such a subject when included in the course of lectures where its principles receive direct application; but, if the naval architect is considered to be a man who applies the principles of engineering to shipbuilding primarily, but who must also meet and overcome difficult problems in allied construction, such as installation of shipyards, design of cranes and derricks, both fixed and floating, to say nothing of the design and construction of various engines, then any influence which unduly narrows his professional horizon is unfortunate.

Before proceeding further in the consideration of engineering education in Great Britain, attention should be given to the long-established custom of receiving young men in engineering offices as pupils or apprentices. This method has, undoubtedly, produced many eminent engineers and has the advantage that the young man, during his formative age, is brought into intimate

acquaintance with his profession or trade, and he early grasps the idea that engineering is rather an art than a science, even though it be the most scientific of the professions. The Scottish universities maintain that their short sessions allow the students to devote half of each year to learning the art of their profession, and that the "sandwich" system is the best solution of the problem of engineering training.

I am informed that the engineering works and companies, especially near Glasgow, co-operate heartily in the system just mentioned, and give substantial encouragement to young men to take full advantage of it. As an instance I may quote the schemes that are maintained by the Leven Shipyard at Dunbarton. They are three in number, as follows:—

1. A bursary in the Burg Academy for the purpose of offering facilities to students for taking up the study of engineering and shipbuilding.

A student gaining one of these bursaries will be taken as a five years apprentice in the Leven Shipyard or engine works; he will be expected to attend the course for naval architects during the three winters required for completing that course; the three summers and two full years in addition he will be expected to work in the yard or engine works, or in the drawing offices. I am informed that such a young man, if he takes advantage of his opportunities, is given every facility that can be granted him to learn all the details of his profession.

2. (*a*) A bursary of £25 a year to the West of Scotland Technical College, tenable for two years with privilege of counting the time in that college toward the five year apprenticeship.

(*b*) Six Science Scholarships of £2 each to evening classes in the West of Scotland Technical College.

(*c*) £2 5*s.* toward meeting railway fares of each bursar during the session.

3. To all apprentices attending the above evening classes who have attained seventy-five per cent. of attendance, half of their fees are returned; and to students obtaining over 60 per cent. in class work prizes are awarded.

The Armstrong College at Newcastle-on-Tyne has a course in Naval Architecture, modelled in general on the course at the University of Glasgow, but not as yet so well developed. Thus far the instruction has been by a lecturer who has had experience both as a teacher and in shipyards. The authorities under the leadership of Sir William White have been trying to get some well-known naval architect to take charge of the department and to give to it the assurance of success that his reputation would command. After some efforts to induce certain individuals to take up the work, a circular was issued setting forth the requirements, the salary, and the privileges, especially the freedom offered for private practice. So late as August it was not known that any one had been appointed to the position. From discussion with persons who are familiar with the methods of British education it appears to be not unusual to advertise for professors and other officers at universities and colleges, and some impatience was expressed at an expression of opinion that such procedure might appear to be lacking in dignity. A certain professorship of Natural Philosophy found about a dozen applicants, any one of whom might have been available. The same college had once three hundred applicants for the position of secretary and director, an office which united some of the duties of the president and of the secretary of an American college.

The day classes in Naval Architecture have been small, not exceeding four. There are larger evening classes, but their work is not of the same grade. The work of Naval Architecture begins with the second year, but there is the disadvantage that Calculus is not available till the end of that year. There are four lectures a week for eight months during the two years, covering the entire field of shipbuilding. Six hours a week for the two years are assigned for ship drawing and design. Students having a keen interest were likely to double the assigned time. There is an attempt to specialize for students, giving some of them designs of merchant ships and others of warships. There was exhibited here and elsewhere a tendency among

Scotch professors and instructors to complain that English students show less earnestness than is found at Scottish educational establishments.

The Glasgow and West of Scotland Technical College, located in the heart of the city, is an old established institution, which has recently erected new and commodious buildings of which any technical college might well be proud. The provision for laboratories of Mechanical and Electrical Engineering will be excellent when these are completed, and students of Naval Architecture will have the advantage of that equipment.

Instruction, leading to the degree of Bachelor of Science, is given in Naval Architecture, though they have no professor in charge and apparently do not expect to supply the deficiency in the near future. Lectures are given by a well-known naval architect, who is attached to a neighboring shipyard, the remainder of the teaching being in the hands of instructors. There are but few day students in Naval Architecture, and they work in the general engineering drawing-room.

This college illustrates an important tendency of British engineering education; it has three hundred day students and five thousand evening students. It should, however, be stated that the evening instruction covers a very wide field, from shipbuilding to baking, and that various lines of instruction that approach the work of trade-schools are supported largely by the organizations of various arts or trades in the city. The Director, Professor Stockdale, having expressed his admiration for the large regular classes of American technical schools and colleges, gave as a reason for the relatively small classes in British engineering colleges the excellent organization of their evening classes. The instruction given in the evening may be comparatively elementary, but that is controlled by the grade of men attending, and as advanced work as is given to day classes is offered to any that can take advantage of it. Comparisons are in such case difficult, and are liable to be partial, but an off-hand estimate by the Director was to the effect that the work accomplished by good men in the evening classes was about

one-third that of the day classes,—an estimate that would appear to be liberal. Though a man may attend an unlimited number of successive winters, it is seldom that attendance exceeds three or four years. It is inevitable that the whole scheme of evening instruction must differ radically from that of the day work, and in particular that the fundamentals cannot be taught in the same way, else there would be no instruction given in special branches. A very just criticism of the present American tendency to recruit engineers to an increasing extent from graduates of technical schools was offered in that it tends more and more to separate the engineering workers into two classes, one highly educated but with little personal experience in the manual work of the art or trade, and the other familiar with the processes, but without any knowledge of their rationale. Examples were given of young men who, by aid of evening instruction, had won their way to the front rank of the engineering profession. In this connection it should be borne in mind that throughout Great Britain attention has been given to the provision of evening instruction largely in pure science rather than in special trades or professions. There are various schemes for finding and advancing those who show special aptitude, such as the Whitworth scholarships, which have brought forward many eminent scientists and engineers, and are so highly valued and so widely acknowledged that those who have held the scholarships use the abbreviation Wh. Sch. as they would the recognized form for a degree from an institution of higher learning.

As early as 1799 a technical school was instituted in Berlin, which after various changes was established in 1879 in substantially the present form as the Konigliche Technische Hochschule. In 1884 the institution was installed in the noble buildings now occupied at Charlottenburg, and in 1894 the department of Naval Architecture and Marine Engineering was established on the same footing as other departments like Architecture and Engineering. In 1899 the Hochschule in common with other institutions of like grade was empowered

to grant the degree of Doctor of Engineering, to take rank with the doctorates of the universities. As a matter of fact the time, training, and amount of intellectual effort required to gain the degree of Doctor of Engineering is far in excess of that for any University degree. The regular course of study at a German technical high school leads to graduation with degree of *Diplom-ingenieur*, which may be compared with the degree of Bachelor of Science. Graduates from the courses of Naval Architecture and Marine Engineering receive the degree of *Schiffbau-Ingenieur* or *Schiffmachinenbau-Ingenieur*. The doctorate is awarded for further work of advanced nature; but few doctors' degrees have been awarded by the school, and only one from the department of Naval Architecture.

The department of Naval Architecture and Marine Engineering is housed in the main building with commodious drawing-rooms and lecture-rooms and offices for professors and instructors. Students have the advantages of engineering and other laboratories and all the general facilities of the school. Some complaint was made of lack of instruments and other special equipment.

On the teaching staff are six professors, two *Privat-dozenten*, two first-class assistants, and nine or ten second-class assistants. There are from three to four hundred students enrolled in the department, and twenty or thirty degrees equivalent to *Diplom-ingenieur* are granted yearly. Two of the professors are naval constructors detailed to teach naval design.

In addition to the information obtained during my visit to the Hochschule there has been available for this report a History of the Hochschule, the regulations for the diploma examinations, and other printed matter furnished me by the *Rektor*, Professor Flamm, who is in charge of the department of Naval Architecture, and who further gave every opportunity to inquire into the work of the department. The work of the students in the drawing-rooms was opened freely for inspection, and encouragement was given to talk with the students, many of whom spoke English.

Students are prepared for the Technische Hochschule at the Realschule, or Gymnasia, of which the general opinion is that the scholars work more seriously and are better fitted, especially in Mathematics, than are the scholars in American and English preparatory schools.

The course requires four years' residence at a technical high school, two of which must be at Berlin. There must also be presented evidence of one year of practical work, which can be taken in several periods, partly, if not wholly, in vacation.

Following the traditions of German universities, and in accord with their idea of academic freedom, the course of study which is laid out is only recommended, and it is optional whether the student shall follow it or not. It is, however, very unlikely that a student will depart far from the recommended course and less likely that he could prepare for the examinations if he did. The course of lectures given by the professors and the work covered by such course is effectively controlled by the faculty, as must in fact be the actual working of an education that is so complex and so closely correlated as that given to a modern student of engineering. Especial interest was felt in the amount of time actually spent by students per day on their work; as was to be expected, such a question was repugnant to the idea of academic freedom, but persistent inquiry elicited the information that the average time was not far from eight hours a day.

A very complete system of controlling and facilitating students' work has been made possible and desirable by the large number of students and a corresponding teaching staff. The familiar card catalogue was found in operation and also a large number of printed forms for assignment and calculations of the various problems assigned, together with special notes and pamphlets. All this gave a familiar atmosphere, especially when in the course of conversation students produced printed forms in which they had filled out the computations for experiments in the engineering laboratories.

The drawings were in general finished in pencil, and exaggerated attention appeared to be given to keeping such drawings

clean and presentable, it being in mind that all drawings must eventually be presented at the preliminary and final examinations, which will be discussed later. There is no question that, after a student has once learned to make a proper ink drawing or tracing, he may frequently gain some time by finishing his drawings in pencil, and that further the accuracy of the drawing is better judged in the pencilled condition; but where drawings are kept in hand weeks or months, and where they present much small detail, it is frequently found that the best result, considering both time required and appearance, can be had by making a tracing, especially as a skilled draughtsman may finish much of the small detail in the tracing.

There appeared to be a considerable latitude in both the amount and the quality of the work accepted for a given requirement,—a fact which seemed to come from the tradition of academic freedom. In general the drawings were good, but had a certain amateurish appearance.

All computations and drawings are made under the supervision or direction of instructors and are countersigned to that effect.

Two examinations are required of all candidates for the diploma of the Hochschule, one after two years' residence, and one after four years' residence; the time given in both cases is the minimum, and there appears to be no maximum limit. The conditions for these examinations are given at length in the printed Regulations for Diploma Examinations, from which an idea of the scope of the work may be obtained.

The examinations consist of the presentation of required work (in the department of Naval Architecture and Marine Engineering of drawings and computations) and of examinations. The examinations are oral and appear to be individual, there being a considerable interval of time during which they may be assigned.

For the preliminary examination the following work must be presented, with a statement of the time of completion and the endorsement of the instructor:—

(*a*) Drawings of projections and shadows.

(*b*) Freehand drawings of ornaments. (Optional.)

(*c*) Drawings of parts of machines.

(*d*) Representation of a machine or parts of a machine showing original ideas.

(*e*) Construction drawings of at least three different ships and for one of them the complete standard calculations for displacement, with customary diagrams.

(*f*) Drawings of ship-construction according to the German Lloyds rules.

(*g*) Exercises in Mathematics and Mechanics.

If any drawings are presented without the endorsement of an instructor, the candidate must certify that they were finished by himself independently.

If work is found insufficient, one representation is allowed, but not more.

The oral examination includes:—

I. Physics.

II. Chemistry.

III. Mathematics, including Algebra, Analytic Geometry, Differential and Integral Calculus, Differential Equations.

IV. Descriptive Geometry.

V. Mechanics, including statics and dynamics; strength of cylinders, spheres and straight and curved beams; equilibrium of liquids and gases.

VI. Mechanical technology; qualities of materials; procedure of working, casting and machining; tools and accessories.

VII. Building construction. (Optional.)

VIII. Elements of machines; construction and calculation of parts of machine.

IX. Elements of Political Economy.

The rankings are Unsatisfactory, Satisfactory, Good, and Very Good. A rank of Unsatisfactory in one subject will cause the candidate to fail.

The final examination requires the presentation of the following work:—

FOR THE SHIP CONSTRUCTION COURSE.

(*a*) Construction drawings of at least four different ships, and for at least one of them the work must be carried through the ordinary general

arrangement, division by bulkheads, detailed calculation for speed and for stability at different inclinations.

(*b*) Drawings of the structure and important details of merchant ships according to the rules of the German Lloyds.

(*c*) Drawings of special structures and arrangements, details of warships.

(*d*) Construction drawing of a marine boiler, with detailed arrangement of riveting and necessary calculations.

(*e*) The design of a marine engine with calculation of the principal dimensions.

FOR THE MARINE ENGINEERING COURSE.

(*a*) Construction drawings of at least two different ships, and of one of the same the usual general arrangement as well as bulkhead division.

(*b*) Drawings of parts of the ship to which the machinery is attached.

(*c*) Design of a marine engine, with details of bed-plate, valve-gear, cylinder, receivers, condensers, pumps, shafting, and propeller.

(*d*) Design of two different marine boilers, one design being completed with front end, uptake, and chimney, accompanied by calculation.

As in the preliminary examination the drawings and calculations must bear a statement of the time of completion and must be endorsed by an instructor; or, if the candidate has not such endorsement, he must certify that they have been completed by himself personally. A representation is permitted, if necessary, once only.

If the work presented is satisfactory, the candidate is given an oral examination and is assigned a technical problem or design (*Diplom-arbeit*).

The oral examination covers the following subjects:—

I. Theory of machine; including theory of governors and fly wheels; theory of hydraulic machinery; thermodynamics of steam and gases; steam engines.

II. Kinematics; including simple pairing and kinematic chains; motion in lines, curves, and planes; crank-motion; gearing and ratchets.

III. Machine Design; including calculation and construction of hoisting machines, pumps and blowers, steam engines and valve gearing, steam boilers, hydraulic machinery with valves and piping.

IV. Fundamentals of iron mining.

V. Theory of Ships; including displacement, stability, resistance,

power, propelling machinery, sails, rudder, turning radius, theory of waves and rolling of ships.

VI. Ship construction.

VII. Practical Shipbuilding.

VIII. Warship Construction.

IX. Marine Engine Construction; including engines and boilers and parts of the same, with sketches as required.

X. Translation from technical French and English into German.

The examination for naval architects under the head IX. is cursory, and under the heads V., VII., and VIII. for marine engineers.

The ranks are the same as for the preliminary examination, with failure if any item receives the rank of unsatisfactory. Candidates may have a re-examination at the next examination period if failures are incurred or if a higher rank is desired, but only once.

The diploma design (*Diplom-arbeit*) is given much importance. The candidate for a degree in Naval Architecture must choose and work out one of the problems in the domain of the shipbuilding course which has for its subject an enlarged design with explanations and calculations for the same. The candidate for the degree in marine engineering, in like manner must choose and work out a problem in marine engineering.

The candidate must certify under oath that he has performed the diploma work independently. He may, however, have his descriptive text and calculations copied.

The work must be returned at the end of three months, and it may be returned earlier; delay can be obtained only under special circumstances. If the work is unsatisfactory, a new assignment may be obtained, but only once.

A comparison of our own Course in Naval Architecture with the courses in European schools, even with the evidence obtained from visits to those schools, and from all other sources, cannot be other than hazardous. And yet the opportunity for suggestions for improvements in our own Course demands the hazard. Such comparison can be made either for our regular four-year Course, leading to the degree of Bachelor of Science,

or for our special Course for Naval Constructors, leading to the degree of Master of Science. There is in addition our Graduate Course of one additional year, also leading to the bachelor's degree for bachelors of science who desire to take up warship design.

Of the four leading European courses those at Greenwich and at Paris are governmental schools for naval constructors, and their work can be compared with our Course for Naval Constructors. The course at the University of Glasgow is directly comparable with our four-year Course, while the course at Berlin must be compared with both our Courses. As for the courses at the Armstrong College and at the Glasgow and West of Scotland Technical College, they are not yet completely developed, and those in charge said openly that they are now where we were several years ago; and yet there are suggestions of value from their experience.

As compared with our regular four-year Course, the course at the University of Glasgow has the disadvantage that it consists of three terms of practically five months each; the examination period at the end of the year adds nearly a month of residence at the university. There is no evidence that the young men at entrance are better prepared than are our own, nor is there any compensating advantage to be urged. The work in Mathematics, pure and applied (the latter covering much that is included in our Applied Mechanics), appears to be more affected by academic tradition, perhaps because given at a university where Mathematics is taught mainly as a method of training. The difference to my mind is not so much that the Mathematics for an engineer should be easier as that the attitude of the teacher should be different and that the direct application to the real problem in engineering should always be in mind; this difference is naturally felt most in applied Mathematics, for which there is a direct gain in placing it in connection with the study of the strength of materials. As the course in Naval Architecture is there compressed into eighteen months of actual residence at the university, it is much restricted, and in particular

does not have a broad training in general engineering. Students in that course have always had physical laboratory practice, and now should have the advantages of the new engineering laboratories so far as they are able in the time allowed. It appears probable that the course would be much improved if a student could take four years and thus broaden the general engineering training. So far as can be learned, the theoretical training in Naval Architecture is much like our own in quality and extent, and somewhat more time has been given to ship design, though it is not certain that a correspondingly better training is given. The advantages and disadvantages of having the course under a distinguished practising naval architect have already been discussed.

The particular advantage that this course presents is the good opportunity it presents for parallel work in the profession on the so-called "sandwich" system. A Scotchman who has made himself familiar with their course and our own expressed the idea that we taught more and they gave better practical training. It should be considered whether the Institute cannot in practice obtain that every student in Naval Architecture shall get practical training in shipyards during the summer, and see that opportunities are provided; it may be said that many of our students have taken that course, and that no instance is known in which the opportunity was lacking.

The English technical colleges all have three-year courses, but in general have fairly long terms. The Armstrong College, for example, has about eight months. They have developed to a large extent the tutorial system, and in particular arrange to have students solve numerous engineering problems of graded difficulty in the drawing-room under the eye of the instructor, who is not very likely to help them too much, as the classes for that kind of work are large. This method has an advantage over handing in problems in that students must in all cases do each one his own work, and there can be no question of improper or undesirable assistance.

Of all the courses examined, the one that appeared to show

the greatest similarity to our own was that at Berlin, though there must be some reserve in such a statement, for the national differences are marked and none of my acquaintances has taken the course there. If the resemblance is real and not superficial, it is most interesting, because American and German technical schools seem to have started from diametrically opposite educational ideals. It is perhaps not too much to say that New England colleges and all that pattern after them began as exalted district schools in which definite tasks were set in textbooks and truths were driven home by good disciplinarians. Much that is good in that system remains, though we use the lecture system where desirable and broaden the choice by options when possible. The Germans, though committed to lectures by doctors who speak with personal authority, and though adhering to the form of academic freedom, have practically confined students of engineering to the comparatively narrow path which experience has indicated as essential to an engineering education. The general belief appears to be that young men come to the technical schools better trained, and especially in Mathematics, though of this I have no direct evidence. The ideal of academic freedom appears even yet to have some adverse influence on the efficiency of teaching, especially in engineering laboratories, where work can best be done by groups. The requirement of extensive experience in shipyards and engine works is a step further than either British or American colleges have been able to go. The amount of drawing and design, especially if we include the *Diplom-arbeit*, is much more than we can obtain or desire to obtain from our students.

Since the German naval constructors are drawn from graduates of the schools at Berlin (or Danzig), it is proper to compare with their training our Course for Naval Constructors. In such a comparison it should be borne in mind that the officers designated for instruction at the Institute have had four years at Annapolis of severe drill that covers a wide field, after which they have two years at sea, and then come to us for three

years. In the three years at the Institute they have the theoretical work of our regular Course in Naval Architecture, together with Applied Mechanics, Steam Engineering, Dynamics of Machines and Marine Engines, and also an extensive course in Electricity, with laboratory practice. There are also advanced courses in Mathematics. The work accomplished in warship design is believed to be at least as good as that given at Berlin to students who elect that branch of their profession. A very important part of the training for constructors is obtained during the summer vacations at the electrical works and steel works.

As was pointed out in the description of the course for naval constructors at the Royal Naval College, their main source of supply has been from the dockyards apprentices, with a supplemental supply from men who have undertaken a course for naval engineers. These men, especially the dockyards apprentices, have good practical training before coming to the colleges, and there is less reason for supplementing it than exists at any other college for naval constructors; nevertheless, they have considerable laboratory work and are drafted into the dockyards in summer. The standard in Mathematics is purposely put on a par with that for honor men at the Universities, a fact which appears to be an element at once of strength and of weakness; of strength, in that there can be no question that the graduates of the school can grapple with any problem that will yield to mathematical treatment; of weakness, in that the desire to make the standard equal has tended to make it identical with that at the Universities, and in consequence apart from the proper engineering ideal. The teaching of Applied Mechanics and Steam Engineering is under revision, and is likely closely to resemble our own. My impression is that the work in electricity is better at our school. Warship design is carried on with the advantage of supervision by a constructor who is in active service, with, however, the consequence that the instructor must change from time to time.

The course for naval constructors at Paris is at once very theoretical and much cumbered with descriptive lectures, which go into the minute details of materials, tools, and processes which could better be learned at navy yards. There can be no question of the mathematical training of the students, but their facility in Mathematics appears to lead them occasionally to fill lacunæ in reasoning and information with mathematical operations, as will be found in many works on Naval Architecture by men in the corps of constructors. They have no laboratory work at the École d'Application du Génie Maritime and but little at the École Polytechnique. At the present time they have some shop work, as was stated in the description of the course. They have extensive lectures in electricity, but mainly of a theoretical nature. During the summer they inspect work in dockyards and make written reports. The warship design and engine design is carried through in a thorough and systematic manner.

In conclusion, it may not be too much to assert that our courses for private students and for naval constructors need not fear comparison with those of any college. And, further, it may be said that there appears to be no reason why any American should go abroad to study Naval Architecture, even though it be admitted that residence at a foreign school or university has distinct advantages in giving variety and breadth of education, and for that and other reasons has always been favored by our faculty for men seeking an advanced degree, even when we are prepared to offer equal facilities. To be specific, attention may be called again to the fact that the English and French governmental schools are not open to foreigners. On the other hand, the policy of the German technical schools appears purposely to make the acquisition of the degree of doctor of engineering so difficult that a disproportionate effort and time would be required by an American, even if he did not find the language an additional obstruction. The University of Glasgow requires a residence of three academic years at some

British university before the bachelor's degree can be attained, and offers the doctor's degree only to its own graduates after five years' practice, in consideration of private research. Should a young man desire the advantages of foreign residence with the object of broadening his professional training in Naval Architecture, he is advised to try for a place in some shipbuilding establishment or in the office of some consulting naval architect, and in any case should give his attention to the examples and methods of construction and yard management.

C. H. PEABODY.

DEPARTMENT OF MATHEMATICS.

The year has been one of gradual progress along lines indicated in previous Reports. The increase in the assignment of time to Differential Equations for students in Mechanical Engineering, Chemical Engineering, and Naval Architecture has enabled the Department for the first time to give a satisfactory course to these students. In the Calculus Professor Osborne has carried through a revision of his text-book, making important changes, but his health has not proved equal to the completion of publication in time for use this year. There is every reason to count on the use of the new text next October. The revision of the first-year course by Professors Woods and Bailey has been carried on with energy, and the new text-book will be ready for the next entering class.

One of the important objects of the revision of these fundamental mathematical courses is their better adaptation to later actual use in engineering study and practice. The Department will welcome suggestions from graduates or others reading this Report which may facilitate the attainment of this end.

A conference with principals and teachers of Mathematics was held by the Department, with the co-operation of the Faculty Committee on Entrance Examinations, last May, with interesting and helpful discussion of the results of entrance examinations

in Mathematics. The proportion of failures in Algebra continues to be regrettably large, but it is the hope of the Department that continued emphasis on the importance of thorough preparation in this subject for students who are coming to the Institute, but whose interests may have been at times subordinated to the interests of other students preparing for admission to college, will have advantageous results, without involving hardship to schools and candidates.

During the present term the work of the Department has been somewhat seriously hampered by the simultaneous absence of Professors Osborne and Wells and the partial detachment of Professor Bartlett for service as Acting Secretary of the Institute, the situation in regard to Professors Osborne and Bartlett not having been anticipated in time to make an additional appointment for the first term. It is hoped that Professor Osborne will resume his work at the beginning of the second term with health fully restored.

Other changes in the mathematical staff include the granting of a year's leave of absence to Professor Wells on account of ill-health, the well-earned promotion of Dr. Woods to a full professorship and of Mr. George to an assistant professorship, the return of Mr. Miller from two years of graduate study at Göttingen and Harvard, and the departure of Mr. MacDonald for graduate study.

In connection with Professor Bartlett's administrative appointment he has been relieved of a considerable portion of his teaching duties and of the care of the Runkle Library of Mathematics. From the time of his original appointment in the Department in 1886 he has interested himself zealously in the development and care of this library, and its present excellent condition is in great measure the result of his efforts. A larger appropriation for the present year has made it possible to increase the supply of books of reference in the library and to fill certain gaps in the files of periodicals.

H. W. TYLER.

DEPARTMENT OF DRAWING AND DESCRIPTIVE GEOMETRY.

During the past year there have been no changes in the instructing staff of the Department.

The course in Descriptive Geometry has been somewhat modified, and printed notes have been given to the students. These printed notes will appear in pamphlet form the coming year.

A very complete idea of the course of instruction given by the Department of Drawing in the first and second years may now be obtained from the two text-books, "Mechanical Drawing" by Professor Adams, completed last year, and "Descriptive Geometry," by the same author, to be completed this year. One of the special advantages in having these text-books is in connection with the preparation of students desiring to anticipate our work in drawing before entering the Institute. Detailed descriptions of instruments and their methods of use in Mechanical Drawing have already been found of great advantage in indicating the standard of work demanded. The officers of many colleges have written to the Institute to ascertain the exact requirements for admission to our third and fourth years. As both Mechanical Drawing and Descriptive Geometry are rarely given in our colleges of liberal arts, these subjects have been stumbling-blocks to almost all candidates from such colleges. The summer courses to a certain extent enable men to anticipate this work, but there are many men who find it quite impossible to attend summer courses. To such men the two text-books, "Mechanical Drawing" and "Descriptive Geometry," will convey a complete idea of the method of instruction employed at the Institute.

In the text-book on "Descriptive Geometry" a special effort has been made to train the student to see objects in space, and to make this subject of general educational value. Descriptive Geometry holds a unique place in scientific education. There

is no other subject which does so much to develop the special sort of imagination required in engineering drawing.

The blue-print outfit asked for last year has been provided; also the cases for models and drawings. A large number of examples of standard drawings have been framed and hung on the walls of the drawing-room. The remaining needs of the Department were well set forth in last year's Report.

An interesting proof of the improvement in the instruction in the Department of Drawing is given in the relative percentage of good and poor marks received during the past year, for, though the standard has been kept as high as ever before or higher, we find that in Descriptive Geometry over sixty-seven per cent. of all the students have obtained very satisfactory records, Pass or Credit, while only about ten per cent. received total failures. In Mechanical Drawing over seventy-five per cent. obtained records of Pass or Credit, and less than four per cent. received total failures. This record compares favorably, not only with our own past records, but with the records of other colleges teaching these subjects.

ALFRED E. BURTON,
In Charge of the Department of Drawing.

DEPARTMENT OF MECHANIC ARTS.

The total number of students receiving instruction in the Mechanical Laboratories is two hundred and forty-six. Some attend more than one class, the numbers attending in the several subjects of the first year being as follows:—

Carpentry and Wood Turning, II.	60
Joinery and Pattern Work, VI.	24
Forging, II. and XIII.	88
Metal Turning, VI. and VIII.	34
Machine-Tool Work, II. and XIII.	54
Total in all classes	260
Students taking work in two or more classes and counted more than once	14
Total number of students	246

The total number of students attending last year was three hundred and thirty-one. As formerly, many students have been excused from attending the Carpentry, Wood Turning, and Forging classes, and a few from Pattern Work. The number of excuses granted in these earlier subjects is increasing but is not yet sufficiently large to warrant giving courses in advanced Wood Work, an arrangement which may prove desirable in the future.

The attendance in the Summer School was fifty-six, an increase of eight over that of last year. The numbers in the several classes were:—

Wood Work	4
Forging	16
Chipping and Filing	9
Machine-Tool Work	27
Total	56

The proportionally large attendance in Machine-Tool Work is due to the desire on the part of many students to anticipate the Mechanic Arts of the senior year, in order to obtain additional time for thesis or other departmental work.

The lap-jointed boiler installed in 1883 has been replaced by a sixty-inch butt-jointed boiler safe at a working pressure of one hundred and fifty pounds.

A new universal grinding machine and a new arbor press have been added to the equipment of the Machine-Tool Laboratory. A new Jones and Lamson turret lathe has been given in exchange for the old machine. Our old Brown and Sharpe universal grinding machine is to be replaced by a new and modern tool. Six new anvils, a swage block and stand, have been added to the equipment of the Forging Laboratory. New jack and block planes have been added to the equipment of the Wood Working Laboratory.

To maintain the present high standard in Machine-Tool Work, fourteen engine lathes and a planer purchased in 1876 should be replaced by modern machines, some of them large enough to illustrate the use of high-speed tool steels. A small

radial drill is also needed to carry on the class work successfully.

By thorough repairing the equipment of the Forging Laboratory has been put in fair shape; its renewal will, however, be necessary in a few years.

As previously stated, it is believed that instruction in Foundry Work should be given to every student in Mechanical Engineering, because of the value of a thorough knowledge of this important subject in many industrial works. The course is now optional. It is again recommended that a new and larger melting plant be installed, since under present conditions it is extremely difficult to obtain good results. It is believed that this course should be required even if time for it has to be taken from some of the present courses.

The interior of the building has been painted during the summer, and now presents a better appearance than ever before. An electric lighting plant is very much needed in place of the present inadequate gas-lighting system. A new solid plank floor should be laid in the Machine-Tool Laboratory.

No changes have been made in the instructing staff, the present force consisting of four instructors and five assistants.

PETER SCHWAMB.

DEPARTMENT OF ENGLISH.

The English Department made this year its first trial of entrance examinations under the new conditions. The arbitrary requirement in preparatory work of a list of prescribed books has been done away with; and teachers are now free to choose such works of literature as seem to them best adapted to the needs of individual classes. The examinations are now made more completely tests of the results upon a candidate of his training in the secondary schools. He is tried in composition especially for the accuracy of his thought and his power of expression; in literature for his realization and ap-

preciation of the qualities which make literature of worth. The Department feels that it has reason to be pleased with the results, both in the papers actually written by candidates for admission, and in the effects, so far as they are yet evident, of the attitude of secondary schools toward the work of the Institute. A number of teachers in the preparatory schools have voluntarily expressed approval of the change; which, indeed, is one that must sooner or later be generally followed.

Interest in the third-year option in Advanced Composition seems to be increasing. The difficulties of adjusting the hours of general studies to the tabular views of the various Courses have thrown out about a quarter of the men applying for this subject; although in order to accommodate them the course has been divided and is given in two sections. In spite of these disadvantages (of which the second affects only the instructor), the work is taken up with much spirit and is producing excellent results.

A new option offered by Mr. Seaver on "The English Bible" is this term taken by a small class, which shows much interest.

In the *personnel* of the Department no changes have been necessary this year. The division of work is practically the same as last year; and the work received from other departments is not materially altered.

ARLO BATES.

DEPARTMENT OF HISTORY.

The instruction in History continues to be carried on largely along the lines of the last two or three years,—although, it is hoped, with ever-increasing efficiency. In addition to this work the writer, as chairman of the Faculty Committee, has had charge of the General Options of the third year; and a few words relating to these may be of interest. On account of the increase in the requirement in Modern Languages for admission to the Institute, and a corresponding diminution in the time given them after entrance, which had the effect of re-

moving Modern Languages from the third year, two hundred and seventy hours were set free. The Faculty voted that one hundred and twenty hours of this time be assigned to studies of a non-professional character, and that the remaining hours be used as each department might see fit.

This change took effect in the year 1905–1906. The options provided for included the subjects of Economic History and practical Economics; English Composition and English Literature; History,—including History of Science,—Government, and International Law; French, German, and Spanish. Forty-five hours were assigned to the first term and seventy-five to the second. All regular students must fulfil the requirement in General Options, but students coming from other colleges are excused from this requirement, as from any other, provided they are able to offer a satisfactory equivalent.

The experience of one year is perhaps too brief to warrant the drawing of any conclusions as to the success of these options; but, so far as can be judged, the results have been generally satisfactory. The choices by the students have apparently been made with care; and it is worth noting that members of different Courses have distributed themselves quite widely among the options offered, and have not concentrated in any particular one in any case. This would seem to indicate that the options have been wisely arranged to carry out the original theory that they should be of a non-professional nature, intended to introduce the student to subjects and to lines of thought which shall be of advantage to him in his subsequent career, somewhat aside from the technical demands of his profession.

CHARLES F. A. CURRIER.

DEPARTMENT OF ECONOMICS, STATISTICS, AND POLITICAL SCIENCE.

The Department of Economics has little new to report. The concentration of time devoted to the general course in Political Economy given to the third-year class has been beneficial. It is believed that the course as now arranged, with three hours per week for one term, makes a more serious impression and is followed with a more sustained interest than formerly, when the work was spread over two terms with but two hours in the first and one hour in the second.

The options of Economic History, Railroads, and Banking were well attended, and, so far as can be judged, were chosen after a careful consideration by the students to meet their special needs.

There is now much more opportunity for individual work and conference, and the possibilities of further development in this direction are encouraging.

DAVIS R. DEWEY.

DEPARTMENT OF MODERN LANGUAGES.

During the summer vacation Mr. Hare was lost to the Department by resignation. His place was filled until October fifth by Mr. F. W. C. Lieder, and on and after that date by Mr. G. R. B. Meister.

The experiment was made this year of having foreign books on the lists for Summer Reading: French, German, and Spanish on the second-year list; and French and German on the first-year list. The results, as determined from the reports of students, may be tabulated as follows:—

Year.	No. of reports received.	No. of foreign books read.	No. to every ten students.
First	154	18	1.17
Second	194	25	1.29
First and second . .	348	43	1.23

These results seem to warrant at least a repetition of the experiment.

The reduction of the Modern Language requirements of students in Courses I. and XI., from two languages to one, has not materially lessened the work of the Department. On the first of November the students taking Modern Languages numbered seven hundred and twenty-one, only twenty less than last year. The size of the average section is eighteen, or one and one-half per cent. less than last year. The number taking Spanish is eighty-three, or eleven per cent. of the number taking Modern Languages, as against thirteen per cent. last year. This falling off may be attributed to the change of the work in Elementary Spanish from one hundred and twenty to one hundred and eighty hours a year, and a consequent loss of favor by this course as a third-year option. Only five sections number more than twenty-five students as against ten sections last year.

For the first time in four years recitations have been held in Italian. Mr. Erhardt has a class of nine students of this language.

According to the programme of the Institute, the courses in Elementary French and Elementary German will be discontinued after the current school year. These courses comprise at present six sections, holding altogether eighteen hours of recitation per week.

JOHN BIGELOW, JR.

Reports of Administrative Officers.

REPORT OF THE SECRETARY OF THE FACULTY.

The attention of the Faculty has been occupied during the past year with several important matters of new business, besides those of regular continuance or recurrence.

In the curriculum a change of possibly far-reaching significance has been made in reducing by one-half the time assigned to the study of French and German in the Courses in Civil and Sanitary Engineering. Students entering with Elementary French and Elementary German are required under the new schedule to take but one year's work in either language, instead of one year's work in each as before. This change has long been urged by the Department, and may perhaps be sought by other Departments, in view of the steadily increasing pressure of professional subjects and the diminishing relative importance of technical literature not accessible in English. A special committee has been appointed by the Faculty to report on the general policy to be followed in connection with future changes of the same character.

The distribution of third-year students among the new general options is as follows:—

Advanced English Composition,	28	History of Science	45
English Literature of the Eighteenth Century	26	Advanced French	11
The English Bible	5	French Colloquium	24
Colonial Systems	11	Advanced German	24
Economic History	31	German Colloquium	16
International Law	102	Elementary Spanish	74

In January the Faculty was invited by the Executive Committee of the Corporation to appoint a chairman for the dis-

charge of such duties as might be assigned in consequence of the resignation of the President. Professor Noyes was elected Chairman February 7.

Near the end of the year a special committee on Faculty Organization was appointed to report on a plan presented by the President for changes in the conduct of Faculty business. The committee has not yet reported upon this matter, but has been occupied since the beginning of the school year with questions growing out of the action of the Executive Committee in discontinuing the "Secretaryship of the School" and establishing a Secretaryship of the Institute. With a view to devoting his full time to the work of the Department of Mathematics in accordance with the terms of the Executive Committee's vote, the writer presented his resignation as Secretary of the Faculty, September 26. On its acceptance, November 14, Professor A. L. Merrill, of the Department of Mechanical Engineering, was unanimously elected Secretary of the Faculty.

The Standing Committee on Advanced Degrees and Fellowships has taken up during the year the question of securing due consideration for Institute graduates applying for the degree of Doctor of Philosophy in German universities. Under recent action by some of the Prussian universities preference is given to graduates of institutions included in the Association of American Universities. Application has been made in the name of the Corporation and Faculty that Institute graduates receive equally favorable treatment, on the ground that they are not less well qualified as shown by past experience. The text of this application was reprinted in the *Technology Review* for April, 1906.

On recommendation of the same committee the following persons have been appointed Fellows: Messrs. D. F. Comstock, W. K. Lewis, R. C. Tolman, G. W. Eastman, W. E. MacDonald, and E. W. Washburn.

Financial grants amounting to $5,850 have been made to fifteen persons for graduate study, ten at the Institute, and five for work elsewhere. At the end of last year the master's de-

gree was awarded to nine candidates, including three naval constructors. There are at present eleven candidates for that degree, and ten for the degree of Doctor of Philosophy.

The work of the Standing Committee on Undergraduate Scholarships is summarized in the Registrar's Report, page 137.

The procedure with students entering the Institute from other colleges with advanced standing has been the subject of Faculty consideration during the year. It has been voted to excuse the bachelors of arts entering above the second year from first-year English and United States History, second-year English Literature and European History, the third-year general option, and the summer reading. Graduates entering the third year of the Courses in Chemistry, Biology, or Physics may also offer an equivalent for Mechanical Drawing and Descriptive Geometry.

Interesting correspondence has been had with several colleges with reference to the adjustment of their work to the needs of students preparing to enter the Institute with advanced standing, and further recommendations have recently been presented to the Faculty with a view to emphasizing the attractiveness of the opportunities which the Institute can offer to such students. These recommendations, which have been adopted by the Faculty, but not yet worked out in detail, include the provision of three-year programmes of study leading to the degree of Master of Science for college graduates who have completed all but the technical subjects of the first two years of one of the undergraduate Institute courses. These programmes will probably be published before the close of the school year.

The work of the writer in general administration has ended with the recent discontinuance of the Secretaryship of the School and with the acceptance of his resignation as Secretary of the Faculty. A share of such administrative work must always be absorbed in necessary routine,—the mere lubrication of the machinery of education. The writer ventures

to hope, nevertheless, that his efforts to continue the development in the secretaryship of the Faculty of a strong co-ordinating and centripetal agency, counterbalancing in some measure the centrifugal and possibly even disintegrating tendencies of expansion and departmental specialization, may prove to have some permanent significance, as a contribution however slight toward keeping the Institute something more and better than a combination of departments.

In closing this service, he desires to express his high appreciation of the constant co-operation and generous support he has received from his colleagues in the Faculty, and of the efficient and faithful service rendered by members of his administrative staff, extending in some cases over nearly the entire period.

H. W. TYLER.
Secretary of the Faculty.

REPORT OF THE DEAN.

During the greater part of the school year the work of the Dean's office has been under the efficient charge of Professor A. L. Merrill of the Department of Mechanical Engineering. Professor Merrill had regular office hours for consultation with students and took charge of the various committees of which the Dean is chairman. This arrangement proved to be most satisfactory in every way to the Faculty and to the student body.

During the year the routine work of the office was carried on as usual. The lodging and boarding house list was kept up, and was consulted very largely by the new students. In addition to the endeavor made by the Dean's office to find outside employment during the term and for the summer vacation for such students as made application for assistance in this direction, Mr. Rand, the Bursar, found employment for some students who applied to him, and Mr. Gates, the

college secretary of the Y. M. C. A., also kept a list of available positions.

On Wednesday evening, December 27, 1905, students who were unable to be at their homes during Christmas week were entertained at the Technology Club, by invitation of Mr. Guy Lowell, President of the Club. Over fifty men were present and enjoyed an illustrated talk by Professor Derr on a trip which he had taken through Japan. There were students present from England, China, Japan, South Africa, India, Egypt, Uruguay, and Mexico.

On three successive Wednesdays, December 6, 13, and 20, from four to five o'clock, short addresses were given to the first-year students by the heads of the professional departments, outlining the nature of the studies pursued in their respective Departments. These talks were intended to assist the students in choosing their courses of study, and were preceded on the first afternoon by an address by Dr. Tyler, who outlined in a most excellent and comprehensive manner the work of the Institute and pointed out the reasons which should guide a student in the selection of his course of study. Attendance at these exercises was compulsory, and was made a part of the prescribed work in English, each student being required to present an abstract of at least one of the addresses delivered on each afternoon.

Upon Professor Burton's return from Europe September 1, after a year's leave of absence, he again took up the work of the office. The customary arrangement for meeting new students in the General Library for advice and consultation on the Monday and Tuesday preceding the opening of the term was carried out as usual. Advisers were appointed for all new students, men from other colleges who were entering with advanced standing being assigned, when practicable, to the heads of the Departments in which they were to take up work. In general the number of students assigned to one adviser does not exceed eight.

On Friday evening, October 26, the Technology Club united

with the Walker Club in giving a reception to all new students entering the Institute from other colleges. More than one hundred and fifty invitations were sent out, and there was a good attendance. After brief addresses by the Presidents of the clubs and by the Dean, opportunity was given for the men to become acquainted. This reception has always proved to be of great benefit to the college men, as it is almost the only opportunity which they have during the first year to meet those outside their own courses of instruction.

Mr. John F. Mahan, coach for the athletic teams, reports that the approximate number of men who have taken part in the different kinds of recognized athletics carried on by the Massachusetts Institute of Technology Athletic Association is as follows:—

Track Athletics	90	'09 Tug-of-war	61
Hare and Hound Run	30	'10 Football Team	26
Basket Ball	30	'10 Tug-of-war	65
Lawn Tennis	25	Total	344
'09 Football Team	17		

The approximate number of students who used the Technology Athletic Field from September 26 until October 27 is ninety men per day.

STATISTICS OF ILLNESS FOR THE SCHOOL YEAR. 1905-06.

Fourth-year Class.

There were three hundred and eighty-one students, regular and special, in the fourth-year class. Of these twenty-two were reported ill during the school year 1905–06. Classified by diseases, there were the following cases: abscess in throat, 1; eye trouble, 4; grippe, 1; injury to foot, 1; injury to hand, 1; mumps, 2; ptomaine poisoning, 1; rheumatism, 1; sprained ankle, 1; typhoid fever, 1; not specified, 7. There was one death in this class, that of Mr. P. K. Dodge, on March 19, 1906, due to accident.

Third-year Class.

The whole number of students in this class was three hundred and fifty-eight. Of this number twenty-five were reported ill during the year.

Classified by diseases, there were the following cases: bronchitis, 1; cholera morbus, 1; eye trouble, 2; grippe, 3; injury to arm, 1; injury to leg, 1; indigestion, 1; jaundice, 1; malaria, 2; measles, 1; typhoid fever, 1; cases in which illness was not specified, 6.

Second-year Class.

The regular and special students in this class numbered four hundred and nine, of whom forty-one were reported ill during the school year. The following cases were reported: boils, 1; cold, 1; eye trouble, 1; felon, 1; grippe, 1; injury to eye, 1; injury to foot, 1; measles, 5; mumps, 1; operation on nose, 1; overwork, 2; pharyngitis, 1; sprained ankle, 1; tapeworm, 1; tonsillitis, 1; typhoid fever, 1; unspecified cases, 11.

First-year Class.

The first-year class numbered two hundred and ninety-two. Of this number twenty-nine were reported ill during the year. Classified by diseases, the cases were as follows: appendicitis, 1; bronchitis, 1; cold, 1; diarrhœa, 1; eye trouble, 2; grippe, 3; injury to foot, 1; malaria, 1; measles, 1; overwork, 1; rheumatic fever, 1; rheumatism, 3; stomach trouble, 1; tonsillitis, 3; illness unspecified, 7. There was one death in this class, that of Mr. W. H. Wingate, on February 5, 1906.

SUMMARY.

	No. in Class	No. Ill.	No. of Deaths.
Fellows and Graduates	26	—	—
Fourth Year	381	22	1
Third Year	358	25	—
Second Year	409	41	—
First Year	292	29	1
Total	1,466	117	2

ALFRED E. BURTON, *Dean.*

REPORT OF THE DIRECTOR OF PHYSICAL TRAINING.

This Department has become well established in the new gymnasium, and has greatly increased facilities for work and development. Our new quarters are well heated, lighted, and ventilated, and are in every way a great improvement over the old gymnasium.

Owing to the lateness in getting into the new building, the work of the Department was somewhat delayed. Only about seventy-five men took physical examinations in the fall, and regular class-work did not begin until December 11th. The work was of the same general character as that of the preceding year. Much interest was displayed by the classes, and this continued throughout the year. In January the Gymnastic Team, formed for the purpose of stimulating interest in heavy gymnastics, began work, and on April 13th gave a very successful exhibition in the gymnasium. About thirty men took part. Regular class-work continued until April 20th, when the second physical examinations began. About sixty men took these examinations, and in all cases there was great improvement. The Cabot Medals for Improvement in Physical Training were awarded to L. T. Tuckerman, '06, J. E. Tresnon, '07, P. P. Greenwood, '07, J. F. Tobin, '08, and F. Jaegar, '09.

WINFIELD C. TOWNE,
Instructor in Gymnastics.

REPORT OF THE MEDICAL ADVISER.

There have been no important changes in the work of the Medical Adviser's Office during the past year. Consultation hours have been held as usual in the Pierce Building twice a week, and the students have fully utilized the appointed time, four to five o'clock in the afternoon. As a rule, more students came for advice than could be seen in an hour, and the time of consultation was extended when necessary, so that each man was seen. This extension of time varied with the season. On a half-dozen occasions, during the winter months, nearly two hours additional were needed. In the late spring no extra time was needed as a rule. The average extra time required for consultation throughout the year was thirty-five minutes more than the appointed hour.

The following table gives the number of office visits made and

the number of students seen. A few figures of the previous years are given for comparison.

	1904.	1905.	1906.
Total number of office visits made	349	406	345
Total number of different students seen	185	191	195
Greatest number of students seen per day			11
Least number of students seen per day			2
Average number of students seen per day			6
Number of students making more than one visit			61

A comparison of these figures for the last three years shows that the amount of work of the medical office remains fairly uniform from year to year, and that the time at present devoted to giving medical advice to the students will probably prove sufficient for their needs in the immediate future.

It is evident that more than two-thirds of the men found it necessary to make only one visit, usually for the treatment of some acute and promptly curable condition.

A classified list of the diseases treated, and the number of each, will be found at the end of this report. A large number of conditions were treated, the most numerous being diseases of the digestive apparatus, of the nose and throat, of the skin, and surgical affections. About a dozen men suffered from severe illness, such as appendicitis, Bright's disease, malaria, jaundice, goitre, cocaine habit, and fractures. Two men had to leave the Institute on account of pulmonary tuberculosis. A small number of students were referred to specialists for treatment of the eye, ear, and skin. A small number of students were referred to the Massachusetts General Hospital, where the Institute has free beds for the treatment of such acute diseases as appendicitis, grippe, malaria, asthma, fracture, etc.

In addition to the work at the Institute office I have seen about sixty sick men at my private office and a much smaller number at their homes.

In addition to sick students, six healthy men were examined for the United States Civil Service, or for athletic teams. Each year I see about a dozen healthy men, who are anxious about

their physical condition, and whom it is a great satisfaction to be able to reassure, and to keep out of the hands of quacks.

Each year the Medical Adviser sees a few men who get tired early in the fall term and in whom the cause of this unfortunate condition is found in too arduous or continuous work through the summer. If the officers of instruction at the Institute have an opportunity to advise the students about summer work, I think it is very desirable that they should tell the men that it is wise to take some rest at the end of the school year before beginning summer work, and again during September before the fall term begins.

The number of contagious diseases at the Institute for the year is as usual very small, owing, no doubt, to the scattered residence of the men. The men have a very strong and natural desire to return to the Institute promptly after illness, in order not to get behind in their work, and the temptation is great to cut short the necessary period of quarantine after contagious disease, so that it is not surprising that now and then a man is found who is a little careless about exposing his fellow-students to infection.

The discovery the last year that an Institute janitor had well developed tuberculosis of the lungs, and a sputum loaded with the germs of the disease, indicates the necessity for some control or inspection of the Institute workmen in case of illness.

Three talks on personal hygiene were given by the Medical Adviser to the whole freshman class upon the following subjects:—bathing, exercise, care of the eyes, the use of tobacco and alcohol, minor ailments and emergencies, and the prevalence and dangers of venereal disease.

At the suggestion of Professor Talbot a talk was given the instructors and students of the Chemical Department upon the emergency treatment of injuries to which chemists are especially exposed. The subjects covered were burns, including those made by mineral acids and phosphorus, the treatment of suffocation or poisoning by gases such as hydrogen sulphide, carbon monoxide, chlorine, bromine, ammonia, hydrocyanic

acid, arseniureted hydrogen, ether, and turpentine vapors and poisoning by the accidental swallowing of mineral poisons. The emergency treatment of cuts and hemorrhage was outlined, and the method of carrying on artificial respiration demonstrated. In addition to the lectures and work of caring for sick students, letters of parents about the health of their sons have been answered, advice given to instructors and students about isolation in case of contagious diseases, and upon other topics, such as the risks to health from work in tropical climates or from work in caissons.

DISEASES TREATED BY THE MEDICAL ADVISER.

Stomach and Bowels, 32

Constipation . . . 9	Acute diarrhœa . . 8	Gastric neurosis . 5
Hemorrhoid . . . 3	Appendicitis . . . 3	Tapeworm . . . 2
Gastroptosis . . . 1	Catarrhal jaundice, 1	

Nose and Throat Cases, 31

Acute rhinitis . . 11	Pharyngitis . . . 9	Chronic rhinitis . 5
Nose-bleed . . . 12	Chronic atrophy of	Laryngitis 1
Adenoids 1	tonsils 2	

Skin, 32

Acne 7	Eczema 7	Herpes 3
Urticaria 3	Wart 3	Alopecia 2
Scabies 2	Psoriasis 1	Ringworm . . . 1

Eye, 12

Eye-strain 7	Conjunctivitis . . 3	Foreign body . . 2

Surgical Cases, 35

Abscess 4	Sprain 4	Cut 2
Hernia 4	Ankle sprain . . . 3	Flat-foot 2
Synovitis 2	Fractured rib . . 2	Hematoma . . . 1
Spinal curvature . 1	Ulcer, foot 1	Bruise of elbow . 1
Sprain, finger . . 1	Crushed finger . . 1	Phlebitis 1
Fracture of nose . 1	Septic wound . . 4	

Specific Infectious Diseases, 13

Tonsillitis 6	Grippe 3	Mumps 2
Malaria 1	Measles 1	

Genito-urinary Cases, 15

Varicocele 5	Urethritis 4	Balanitis 2
Nephritis 2	Albuminuria . . . 1	Specific 1

Lungs, 10

Bronchitis	6	Pulmonary tuberculosis	2	Pleurisy	1
Asthma	1				

Heart, 3

Cardiac neurosis	3

Ear, 5

Otitis media	4	Polyp	1

Miscellaneous Cases, 41

Emissions	12	Neurasthenia	10	Phys. exam. for U. S. Civil Service	5
Overwork	4	Muscular rheumatism	2		
Phys. exam. for track team	1	Neuritis	1	Neuralgia	1
Goitre	1	Cocaine habit	1		

FRANKLIN W. WHITE, M.D.,
Medical Adviser.

REPORT OF THE LIBRARIAN.

The total accessions to the Libraries of the Institute during the year ending September 30, 1906, amount to 3,991 items, as follows:—

TABLE OF GROSS ACCESSIONS CLASSIFIED BY SOURCES.

By Purchase	1,313
By Binding	1,093
By Gift, Volumes	1,045
By Gift, Pamphlets and Maps	540
Total	3,991

Comparing these figures with those of last year, it will be noticed that there is some increase in the number of accessions by purchase and by binding, and a falling off of about 270 in the number by gift

Bills approved in this office for the purchase of books and periodicals and for binding and library supplies amount to the sums given below:—

Books and Binding	$5,073.37
Periodicals	1,723.08
Supplies	223.50
Total	$7,019.95

The net accessions, calculated by deducting from the gross accessions the books lost or destroyed and old books reaccessioned, amount to 3,392 volumes, 388 pamphlets, and 136 maps; increasing the total contents of the libraries to 74,695 volumes, and 20,982 pamphlets and maps. The particulars of the growth of the several Libraries in numbers of volumes, pamphlets, and maps, with the amount expended for each Library and the present total contents, are shown in the following table:—

TABLE OF THE NET INCREASE WITH THE COST OF THE SAME DURING THE YEAR 1905–06, AND THE TOTAL CONTENTS OF THE LIBRARIES OF THE INSTITUTE, SEPT. 30, 1906.

LIBRARIES.	Net Increase.				Total Contents.	
	Volumes.	Pamphlets.	Maps.	Cost.	Volumes.	Pamphlets and Maps.
General Library:						
General	202	57	—	$194.60	7,084	5,038
English	57	—	—	102.45	3,372	44
Military Science	6	—	—	3.95	346	9
Walker Memorial	8	—	—	—	485	—
Drawing	11	—	—	17.75	39	1
Totals General Library	284	57	—	$318.75	11,320	5,092
Architecture	130	—	—	324.03	3,935	241
Biology	144	14	—	175.40	3,270	634
Chemistry	468	60	—	847.31	10,295	1,864
Electrical Engineering	207	14	—	438.20	1,225	56
Engineering	802	131	—	1,085.90	12,737	4,573
Geology	108	14	134	167.92	2,762	2,826
History and Economics	388	1	—	342.35	11,895	3,565
Margaret Cheney Room	—1	—	—	8.35*	669	13
Mathematics	149	3	—	304.60	1,644	217
Mining	283	13	2	406.57	4,190	668
Modern Languages	61	1	—	23.26	1,671	50
Naval Architecture	136	2	—	127.71	1,195	106
Physics	232	78	—	503.02	7,887	1,077
Totals	3,391	388	136	$5,073.37	74,695	20,982

An estimate of the present value of the several Libraries of the Institute having been called for in haste, in the early part of the

*Paid for periodicals charged to Cheney Fund.

summer, it seems desirable at this time to place on record a more careful estimate of the capital represented in the Libraries of the Institute. A careful estimate was made in the report for 1898–99. With that as a basis, and adding the amount actually expended for the Libraries from September, 1899, to September, 1906, we obtain the amounts given in the following table:—

ESTIMATED VALUE OF THE LIBRARIES OF THE INSTITUTE, SEPTEMBER 30, 1906.

LIBRARY.	Estimate * 1899.	COST 1899–1906.			Total Value 1906.
		Books, etc., charged to Dept.	Periodical Account.	Total.	
Rogers.					
General	$10,833	$3,267.15	$910.98	$4,178.13	$15,011.13
Mathematics . .	2,028	1,544.11	458.21	2,002.32	4,030.32
Mining	5,196	2,764.48	1,112.75	3,877.23	9,073.23
History and Econ.	13,450	2,783.70	1,162.99	3,946.69	17,396.69
Walker.					
Chemistry . . .	16,932	4,993.51	1,259.56	6,253.07	23,185.07
Physics	13,093	3,629.90	1,122.45	4,752.35	17,845.35
Engineering A.					
Engineering . . .	18,563	7,299.54	2,580.78	9,880.32	28,443.32
Pierce.					
Architecture . . .	18,402	2,871.32	1,121.46	3,992.78	22,394.78
Biology	4,890	1,658.73	1,771.28	3,430.01	8,320.01
Geology	4,412	930.92	296.59	1,227.51	5,639.51
Margaret Cheney R.	1,357	28.95	—	28.95	1,385.95
	Estimated Value of Books Transferred.				
Engineering C.					
Naval Architecture	$1,560	703.32†	83.16	786.48	2,346.48
Lowell.					
Electrical Eng. .	871	1,870.80	177.45	2,048.25	2,919.25
Modern Languages	1,275	267.96	332.57	600.53	1,875.53
Total . . .	$112,862	$34,614.39	$12,390.23	$47,004.62	$159,866.62

* As modified by transfers from Gen. to M. L. 981 at $1.30 . . . . . $1,275
H. & E. to Gen. 1,025 at 1.50 1,538
Phys. to E. E. 396 at 2.20 871
Eng'g. to N. A. 709 at 2.20 1,560

† Including gifts of Dr. Weld, costing $332.22.

In this table the total in the first column of figures is the same as in the report for 1898–99, but the amounts charged to several of the Departments have been modified by the transfer of books to the newly established Departmental Libraries, as indicated in the footnote. In the case of the Department of Naval Architecture, where are placed a large number of gifts from Dr. Weld, the cost of these gifts, so far as known, has been added to the amount charged to the Department. No other account of the gifts received has been made in this estimate, as it seemed fair to assume that the ordinary gifts, consisting largely of government and other official reports, would not more than offset the deterioration of the purchased books. Without taking these gifts into account, it will be seen that the total value amounts in all to $159,866.62.

The General Catalogue has grown during the year by the addition of 6,641 cards, making the total number of cards now in the General Catalogue 80,800. There were 1,272 orders issued for the purchase of books and periodicals and 1,244 orders issued to the binders. So far as a record has been kept of the circulation of books outside the Library, the data in regard to that may be tabulated as follows:—

CIRCULATION.

General Library	1,278	volumes	and	pamphlets.
Biological Library	179	"	"	"
Chemical Library	1,696	"	"	"
Engineering Library	1,820	"	"	"
Mining Library	945	"	"	"
Modern Languages Library	135	"	"	"
Physics Library	1,200	"	"	"

In the preparation of the following table, which shows the number of periodicals and other serials received during the year, special pains have been taken to insure accuracy. Comparing this table with that of the previous year, it will be noticed that the number of subscriptions charged to the periodical account has been decreased by nine, and the larger total is due chiefly to more careful tabulation of the various serial publications charged to the departmental appropriations. In estimating

the cost of exchanges, the actual number of copies of the *Technology Quarterly* that are mailed is taken as the basis. It would seem easy to give an accurate statement of the cost of the periodicals that are purchased for cash, but, as a matter of fact, many of the periodicals, especially those published in Germany, change in price so much from year to year that it is difficult to make a tabulation that will remain true for any considerable length of time.

TABLE OF PERIODICALS AND OTHER SERIAL PUBLICATIONS RECEIVED DURING THE YEAR 1905–06, CLASSIFIED BY DEPARTMENTS AND METHOD OF PAYMENT.

LIBRARIES.	Number Received.					Estimated Cost.			
	Gifts.	Charged to Department.	Periodical Account.		Totals.	Dept. Account.	Periodical Account.		Totals.
			Exch.	Subs.			Exch.	Subs.	
General	39	22	28	27	116	$63.31	$24.00	$86.59	$173.90
Architecture	7	11	2	29	49	58.54	2.00	130.31	190.85
Biology	8	18	15	33	74	75.62	18.00	254.38	348.00
Chemistry	13	48	15	32	108	169.86	32.00	195.17	397.03
Electrical Engineering	7	14	5	5	31	44.34	14.00	27.10	85.44
Engineering	44	68	64	57	233	174.38	102.00	227.27	503.65
Geology	12	8	11	7	38	33.64	4.00	38.90	76.54
History and Economics,	58	51	4	38	151	110.80	2.00	119.56	232.36
Margaret Cheney Room,	—	6	—	—	6	17.20	—	—	17.20
Mathematics	2	4	2	16	24	9.60	2.00	73.53	85.13
Mining	10	12	36	24	82	29.27	64.00	102.85	196.12
Modern Languages	1	1	1	18	21	2.16	2.00	85.18	89.34
Naval Architecture	5	11	5	6	27	53.93	10.00	19.13	83.06
Physics	17	19	22	24	82	79.17	30.00	103.08	212.25
Totals	223	293	210	316	1,042	$921.82	$306.00	$1,463.95	$2,690.87

The General Library has been kept open during term time until 10 o'clock in the evening. The average attendance for the 157 days from 5 to 7 P.M. was 6.4, and from 7 to 10 P.M. 5.7, the total attendance for these periods being 1,011 and 912, respectively.

The more notable gifts received during the year are 56 volumes on Naval Architecture from Dr. Charles Goddard Weld, of the Corporation; four volumes of her works from Mrs. Ellen H. Richards, of the instructing staff; 60 volumes from Mrs.

Jerome Sondericker, these volumes having formed a part of the library of her husband, the late Professor Sondericker of our Faculty; a copy of "The Mechanical and Electrical Inventions of E. K. Adams," 2 volumes, from his father, Edward D. Adams, Esq.; 153 volumes, mostly chemical journals, from Edward R. Warren, Esq., of Brookline, through the courtesy of President Eliot; from Professor C. E. Holmberg, of Helsingfors, four volumes of his works.

The great need of the Library is space. If it should be decided to move the Institute to a new site, provision should be made in the administration building for a much larger General Library than we now have. While the present general reading-room is adequate for the present number of students, if the student body should increase very much in size, a larger reading-room would be required. But the chief need is stack room for the storage of books. The shelves of the General Library are now filled very nearly to their full capacity, as are also the shelves in the adjoining Room 16, the office and lecture-room of the Professor of English, in which have been placed a large number of books of classes not often consulted. In planning new library rooms, there should be provided a room that could be completely filled with book stacks. It should be easily accessible from both the general reading-room and the office of the Librarian, and should be capable of indefinite extension. It would be used not only to store the less frequently consulted books of the General Library, but also—and this would be probably its greatest value—to store surplus books from Departmental Libraries; that is, books that the Institute must keep in its Library, but which are so little used that they could be transferred from the Departmental Libraries to the General Library without serious inconvenience, provided that they can be properly classified and arranged in such a stack as is here suggested.

The ever-present need for more space is felt perhaps most keenly in the office of the Librarian. A well-lighted and well-ventilated room four times the size of the present office would be no more than sufficient for the use of the central library

staff. Every book, periodical, or map, purchased by or given to the Institute passes through this office at least once; if, then, the book has to go to the bindery to be bound or numbered, it passes through this office twice more. Every time a book enters or leaves the office it must be recorded. New books and volumes of periodicals newly bound must be entered in the record of accessions, catalogued, and classified. In addition to all this, duplicate cards have to be made for the Departmental Libraries, unbound books and periodicals have to be taken apart and arranged for the binder, especially those printed in foreign languages, letters have to be written, and the usual work of a business office attended to. In order that such work can be carried on economically and without confusion, there are needed, in addition to the usual desks, large tables where books can be spread out or arranged in convenient piles. The office should be furnished also with sufficient shelves and cabinets to hold the library supplies, to store new books awaiting invoices or classified by Departments preparatory to being catalogued, and recently catalogued books again classified by Departments and awaiting transportation to the Departmental Libraries; and there are needed shelves for a small library of reference books for use in connection with the ordering, cataloguing, and classification of new books. When books are received in large numbers, as frequently happens, it is not possible or economical to catalogue them or to send them to the Departmental Libraries all at once, and storage space for these must be provided. The conduct of such an office with the maximum of efficiency and economy depends upon each member of the staff being employed fully and continuously in an orderly sequence of duties, without hurry, worry, or interruption, and without unnecessary mechanical difficulties to be overcome. For such a condition in this department, the space and conveniences that I have attempted to describe are absolutely essential.

Besides the stream of books and periodicals that is constantly passing in and out of the Librarian's office, there is a large

number that for some reason must be retained for a greater or less period; for example, there are volumes of periodicals that are sent from the Departmental Libraries to be bound, but are found to be defective and must be held until the missing parts can be recovered, or perhaps obtained from abroad; there are duplicates that cannot be disposed of until it is certain that the corresponding volumes have been securely bound and placed upon the shelves of the Library; and, most important of all, there is the great quantity of books and periodicals received between the middle of June and the last of September, which cannot be sent to the Departmental Libraries because no one is there to receive them until the next term begins. Since books are bulky and incompressible, and are received in such numbers, it is impossible to retain them in the present office during the vacation, and do any work there. Storage in various places has been tried, but every summer serious inconvenience and loss is suffered from some of these books being misplaced or stolen. For the safe-keeping of these books an ample storeroom should be provided, opening into the office only and capable of being securely locked. There is needed also a small room opening into the General Library and into the office, and provided with desks for the Librarian and one assistant, this room to be used as a private office where the Librarian can be consulted by officers and students and can transact such business as requires personal interviews without disturbing the other workers.

In the Departmental Libraries the shelves are practically completely filled. The condition is such that in order to place new volumes upon the shelves in their proper places large numbers of books have frequently to be shifted. This not only means great loss of time and wasted energy on the part of the assistant in charge, but it causes great inconvenience to the users of the books, who cannot find them in their accustomed places. The Librarian frequently receives complaints from persons who have difficulty in finding books on this account. Data in regard to the annual growth of the Libraries were given in the report for

1904–05, pp. 85-87. Consideration of those facts would indicate that in planning buildings for the several Departments the space allotted to Libraries should be in most cases twice, and for two or three of the Departments considerably more than twice, the space now used for that purpose. In this connection I wish to urge once more the necessity of an extensible storage space, or stack, connected with the General Library for the relief of the Departmental Libraries. These Libraries, surrounded, as they must be, by the laboratories and drawing-rooms of the Departments with which they are connected, will always tend to grow beyond the space allotted to them, however generous a provision be made for them in the first place. But, if the older and less useful books can be transferred from time to time to the General Library, the Departmental Libraries can easily be kept within their proper limits, and at the same time fully supplied with the latest literature, while we may hope that the Library, as a whole, may retain its present position as the largest and most complete library belonging to any school of technology in this country.

ROBERT P. BIGELOW,
Librarian.

REPORT OF THE REGISTRAR.

The total number of members of the Instructing Staff as shown by the annual Catalogue this year, including those at the Mechanical Laboratories, but excluding the Research Associates and Assistants and those who are announced annually as lecturers only, is one hundred ninety-nine. Counting all, there are two hundred forty-one. Not taking into account the Research Associates and Assistants and Lecturers, the number of members of the Instructing Staff to that of students in regular attendance bears the proportion of one to six and nine-tenths. Last year it was seven and three-tenths.

The number of students has dropped again, this year, from fourteen hundred sixty-six to thirteen hundred ninety-seven, but the number in the first-year class has risen from two hundred ninety-two to three hundred forty-six. The senior class of last year was the largest in the history of the school. This year its place is taken by a smaller one. The third-year class is larger than that of last year, while last year's second-year class is replaced by the small first-year class of last year. The number of regular students is somewhat smaller than the number of the year before, but the ratio of regular students to specials is larger this year.

The number of new students is five hundred forty-six, as compared with four hundred eighty-two of last year. The percentages of new students, for these two years, are thirty-nine and thirty-four, respectively.

The number of graduates enrolled this year is two hundred. This includes fourteen who are either fellows or candidates for the doctor's degree. The number last year was two hundred one. The numbers of colleges and universities represented this and last year are eighty-eight and eighty-five, respectively.

There is no large gain in any of the professional Courses. The Course in Electrical Engineering has the same number of regular students, while there has been a slight drop in the corresponding number in all the Courses, except in Chemical and in Sanitary Engineering, where there has been a slight

gain. The greatest losses in per cent. are those in the Courses in Mining Engineering, Chemistry, and Naval Architecture. There are no regular students in the Courses in General Science or Geology.

The decrease in number of students at the Institute is distributed among all the five divisions of the United States, except the South Central States. Students are now registered from North Carolina, North Dakota, and South Dakota, states that were not represented by students last year. No student, however, comes from Arkansas this year. The students from foreign countries have risen in number from sixty-six to seventy-six, and five more countries are represented.

Forty-three states of the Union and one territory, besides the District of Columbia, Porto Rico, and the Philippines, are represented on our lists of students. Of the total number of thirteen hundred ninety-seven, seven hundred sixty-four are from Massachusetts, or fifty-five per cent. of the whole; the same per cent. as last year. All the counties of the state except Nantucket send students to the Institute.

One hundred thirty cities and towns of this state are on the list. A table shows the number of cities and towns of each county sending pupils, and also gives the aggregate number from each county. Middlesex County sends two hundred thirty; Suffolk, two hundred nineteen; Essex comes third with ninety-eight; Norfolk, fourth with ninety-one.

The registration in the Summer School (two hundred twenty-nine) was less than last year by thirty-seven; the number of students (thirty-nine) from other colleges or schools was smaller, by one, than last year. There was an increase in the number of those who attended to make up failures or deficiencies, while there was a marked decrease in those who were anticipating work. Courses were anticipated principally in Mechanic Arts, Descriptive Geometry, Architectural Design, Languages, Mechanical Drawing, and Surveying; chiefly by former students.

The Faculty Committee on Undergraduate Scholarships, at

its annual meeting for the awards for the current year, entertained one hundred ninety-two applications for aid. One hundred forty awards, amounting in all to $19,420, were made. Thirty-seven of these awards were replaced wholly or in part by State aid, to total amount of $4,925. The number who made applications for State aid and did not ask for Institute aid was forty-two. This makes a total of two hundred thirty-four applications for Scholarship aid. The twenty-nine State awards to those who received no Institute assistance, added to the one hundred forty Institute awards, gives a total number of one hundred sixty-nine students who are receiving scholarship assistance.

As was stated above, the class that was graduated last June was the largest in the history of the school. Of the two hundred seventy-seven who received the degree of Bachelor of Science, one hundred ninety completed the course in four years, while thirty-six fulfilled the requirements in five years, two were at the Institute for six years, and one completed his course in three years. Of the two hundred seventy-seven, forty-eight entered the Institute from other colleges, and, of these forty-eight, thirty came with degrees. It is interesting to note that the largest number and almost one-half of the college graduates spent two years to complete their courses and about one-quarter took three years; only three of the thirty received the degree in less than two years.

The usual tables of statistics for the current year are presented on the next few pages.

THE CORPS OF INSTRUCTORS.

The following table shows the distribution among the several classes of instructors, in comparison with last year:—

	1905–06.	1906–07.
Professors	35	39
Associate Professors	15	18
Assistant Professors	24	21
	74	78
Instructors	72	69
Assistants	53	52
	125	121
Research Associates	6	8
Research Assistants	4	3
	10	11
Lecturers	39	31
Total	248	241

STUDENTS BY CLASSES.

The aggregate number of students for 1906–07 is divided among the several classes, as follows:—

Fellows	7
Graduate students, candidates for advanced degrees	25
Regular students, Fourth Year	178
" " Third "	194
" " Second "	169
" " First "	272
Special students	552
Total	1,397

The following table shows the division of the whole body of students among the several years:—

Class.	Regular.	Special.	Total.
Fellows and Graduates of the M.I.T.	32	—	32
Fourth Year	178	133	311
Third Year	194	182	376
Second Year	169	163	332
First Year	272	74	346
Total	845	552	1,397

THE COURSES OF INSTRUCTION.

The following table presents the number of the regular and the special students in the second, third, and fourth years, by Courses:—

Year.		Civil Engineering.	Mechanical Engineering	Mining Engineering and Metallurgy.	Architecture.	Chemistry.	Electrical Engineering.	Biology.	Physics.	General Science.	Chemical Engineering	Sanitary Engineering	Geology	Naval Architecture	Total.
4th Year Class	Reg.	43	42	10	15	8	29	—	2	—	11	5	—	13	178
	Sp.	22	17	18	23	11	18	4	3	—	5	4	2	6	133
3d Year Class	Reg.	47	49	11	10	10	41	1	4	—	7	3	—	11	194
	Sp.	38	32	16	17	8	44	—	1	—	13	7	—	6	182
2d Year Class	Reg.	29	40	18	14	6	31	3	5	—	12	10	—	1	169
	Sp.	31	34	27	15	6	29	2	3	—	7	3	—	6	163
Total . . .	Reg.	119	131	39	39	24	101	4	11	0	30	18	0	25	541
	Sp.	91	83	61	55	25	91	6	7	0	25	14	2	18	478
		210	214	100	94	49	192	10	18	0	55	32	2	43	1,019

The following table shows the number of regular students in the foregoing table, in comparison with the corresponding figures for the next ten preceding years:—

Year.	Civil Engineering.	Mechanical Engineering.	Mining Engineering and Metallurgy.	Architecture.	Chemistry.	Electrical Engineering.	Biology.	Physics.	General Course.	Chemical Engineering.	Sanitary Engineering.	Geology.	Naval Architecture.	Total.
1896	99	117	24	65	66	106	7	11	11	34	8	—	25	573*
1897	109	119	38	71	60	90	8	9	10	36	7	1	26	578
1898	93	108	52	64	64	94	6	8	12	38	7	1	33	574
1899	99	113	60	53	58	84	8	7	11	30	14	1	38	575*
1900	89	127	69	53	50	87	6	4	8	34	17	1	38	582
1901	102	129	76	40	35	96	6	13	9	30	14	1	39	590
1902	129	133	83	43	58	118	2	20	9	30	12	1	65	703
1903	132	161	91	53	55	126	4	23	6	27	14	1	72	765
1904	140	158	77	41	46	98	4	13	—	32	22	1	49	681
1905	134	149	54	44	36	100	1	13	—	29	13	—	38	611
1906	119	131	39	39	24	101	4	11	—	30	18	—	25	541

* Deducting those counted twice.

GRADUATES BY YEARS AND COURSES.

Year.	Civil Engineering.	Mechanical Engineering.	Mining Engineering.	Architecture.	Chemistry.	Metallurgy.	Electrical Engineering.	Natural History or Biology.	Physics.	General Course.	Chemical Engineering.	Sanitary Engineering.	Geology.	Naval Architecture.	Total.
1868	6	1	6	–	–	–	–	–	–	1	–	–	–	–	14
1869	2	2	–	–	1	–	–	–	–	–	–	–	–	–	5
1870	4	2	2	–	1	–	–	–	–	1	–	–	–	–	10
1871	8	2	5	–	2	–	–	–	–	–	–	–	–	–	17
1872	3	1	5	–	3	–	–	–	–	–	–	–	–	–	12
1873	12	2	3	1	7	–	–	–	–	1	–	–	–	–	26
1874	10	4	1	1	–	–	–	–	–	2	–	–	–	–	18
1875	10	7	6	1	1	–	–	–	1	2	–	–	–	–	28
1876	12	8	7	–	5	1	–	2	3	4	–	–	–	–	42
1877	12	6	8	4	2	–	–	–	–	–	–	–	–	–	32
1878	8	2	2	3	3	–	–	–	–	1	–	–	–	–	19
1879	6	8	3	1	3	–	–	1	1	–	–	–	–	–	23
1880	3	–	3	–	1	–	–	–	–	1	–	–	–	–	8
1881	3	5	6	3	8	–	–	1	–	2	–	–	–	–	28
1882	2	5	5	3	6	–	–	1	1	1	–	–	–	–	24
1883	3	7	5	1	3	–	–	–	–	–	–	–	–	–	19
1884	5	6	13	–	12	–	–	–	–	–	–	–	–	–	36
1885	4	7	8	2	4	–	2	–	–	1	–	–	–	–	28
1886	9	23	7	1	7	–	10	1	–	1	–	–	–	–	59
1887	10	17	8	1	9	–	8	1	1	3	–	–	–	–	58
1888	11	25	4	5	10	–	17	3	1	1	–	–	–	–	77
1889	14	24	5	3	8	–	17	1	1	2	–	–	–	–	75
1890	25	28	3	5	13	–	18	3	2	6	–	–	–	–	103
1891	18	26	4	6	11	–	23	3	3	1	7	–	1	–	103
1892	22	26	4	13	7	–	36	6	1	7	4	6	1	–	133
1893	25	30	5	2	8	–	41	2	–	6	8	–	2	–	129
1894	21	31	4	14	11	–	33	1	3	5	12	3	–	–	138
1895	25	30	3	15	14	–	33	–	2	4	11	4	–	5	144*
1896	26	34	10	24	17	–	48	3	3	7	7	4	3	5	190*
1897	25	40	7	16	20	–	33	2	3	7	12	4	1	9	179
1898	32	41	7	29	25	–	33	3	4	6	9	3	–	7	199
1899	30	37	9	22	22	–	32	2	2	1	10	1	–	8	173*
1900	32	34	21	21	19	–	23	3	3	5	11	4	–	9	185
1901	37	39	18	21	17	–	25	1	1	6	14	4	1	16	200
1902	24	46	14	18	14	–	35	5	3	3	9	7	–	14	192
1903	26	37	27	15	13	–	39	1	4	1	10	4	1	12	190
1904	34	45	32	24	15	–	34	3	13	5	7	2	1	17	232
1905	46	54	26	12	23	–	31	3	3	3	13	5	1	24	244
1906	46	69	38	22	21	–	37	2	7	–	10	6	–	19	277
Totals	651	811	344	309	366	1	608	54	66	96*	154	57	12	145	3,669*
Names counted twice, students graduating in two different years . . .															16
Bachelors of Science															3,653*
Masters of Science, not included in the above															17
Total . . .															3,670*

* Deducting names counted twice (students graduating in two courses).

YEARLY REGISTRATION.

The following table shows the registration of successive years from the foundation of the Institute:—

Year	No. of Students.	Year.	No. of Students.
1865–66	72	1886–87	637
1866–67	137	1887–88	720
1867–68	167	1888–89	827
1868–69	172	1889–90	909
1869–70	206	1890–91	937
1870–71	224	1891–92	1,011
1871–72	261	1892–93	1,060
1872–73	348	1893–94	1,157
1873–74	276	1894–95	1,183
1874–75	248	1895–96	1,187
1875–76	255	1896–97	1,198
1876–77	215	1897–98	1,198
1877–78	194	1898–99	1,171
1878–79	188	1899–1900	1,178
1879–80	203	1900–1901	1,277
1880–81	253	1901–1902	1,415
1881–82	302	1902–1903	1,608
1882–83	368	1903–1904	1,528
1883–84	443	1904–1905	1,561
1884–85	579	1905–1906	1,466
1885–86	609	1906–1907	1,397

The special students this year constitute forty-one per cent. of the whole body, as against forty-two per cent. last year and thirty-five per cent. the year before.

The following table shows, by classes and by Courses, the number of regular students who have registered themselves as electing to distribute the required studies and exercises over the period of five years:—

Year.	Total.	Course.												
		I.	II.	III.	IV.	V.	VI.	VII.	VIII.	IX.	X.	XI.	XII.	XIII.
1st	–	–	–	–	–	–	–	–	–	–	–	–	–	–
2d	5	–	3	1	–	1	–	–	–	–	–	–	–	–
3d	8	2	2	1	–	–	1	–	1	–	–	–	–	1
4th	9	2	2	–	–	–	4	–	–	–	–	–	–	1
5th	6	3	1	–	–	–	–	–	–	–	1	1	–	–
	28	7	8	2	–	1	5	–	1	–	1	1	–	2

The following is the number of students, either regular or special, pursuing certain leading branches of study, in each of the four years:—

	First Year.	Second Year.	Third Year.	Fourth Year.	Total.
Mathematics	334	344	192	–	870
Chemistry	344	103	98	66	611
English	324	225	50	2	601
French	226	–	42	–	268
Physics	–	300	375	48	723
German	188	78	41	–	307
Mechanic Arts . . .	–	130	73	65	268

The following table exhibits for ten years the distribution of the total number of students among two classes: first, those students whose names are found upon the Catalogue of the year preceding; and, secondly, those whose names appear first upon the Catalogue of the year to which the statement relates:—

Year.	(1) Total No. of Students.	(2) No. of Students in the catalogue of the previous year who remain in the Institute.	(3) No. of New Students entering before issue of catalogue.	(4) Of those in column (3) the following number are regular First-year Students.	(5) No. of New Students not of the regular First-year Class.
1897–98	1,198	757	441	277	164
1898–99	1,171	769	402	278	124
1899–1900	1,178	764	414	275	139
1900–1901	1,277	789	488	312	176
1901–1902	1,415	844	571	396	175
1902–1903	1,608	949	659	432	226
1903–1904	1,528	1,042	486	249	237
1904–1905	1,561	986	575	295	280
1905–1906	1,466	984	482	213	269
1906–1907	1,397	862	535	272	263

GRADUATE STUDENTS.

The number of students who are graduates of this and other institutions is two hundred. Of these thirty-two are candidates for advanced degrees, nineteen being our own graduates.

One hundred seventy-five are graduates of the following institutions, and are pursuing undergraduate courses of study with us either as regular or as special students:—

Universities.

Acadia	1	Montevideo	1
Boston	2	Northwestern	2
Brown	2	Ohio State	2
Bucknell	1	Ohio Wesleyan	1
Cambridge	1	Pennsylvania	1
Chicago	1	Princeton	10
Columbia	1	Rochester	1
De Pauw	1	Saint Louis	3
Georgia	1	South Dakota	1
Georgetown	1	Southwestern	2
Harvard	23	Southwestern Presbyterian	1
Havana	1	Spanish	1
Indiana	2	Tennessee	1
Johns Hopkins	6	Texas	3
Louisiana State	1	Virginia	1
McMasters	1	Washington and Lee	1
Maine	1	Wyoming	1
Minnesota	2	Wesleyan	2
Mississippi	1	Yale	7
Missouri	1		93

Colleges.

Adelbert	2	Lafayette	1
Adrian	1	Massachusetts Institute of Technology	23
Amherst	4	New Hampshire Agricultural	1
Anatolian	1	Oregon Agricultural	1
Bates	5	Randolph-Macon	1
Beloit	4	Rhode Island Agricultural	1
Boston	2	Rock Hill	1
Bowdoin	1	Rutgers	2
Bradley Polytechnic Institute	1	Sacred Heart	1
Canisius	1	Saint Johns	1
Case School of Applied Science	1	Saint Vincent	1
Centenary of Louisiana	1	Saint Xavier	1
Central Technical, London University	2	South Carolina	1
Centre	1	Texas Agricultural and Mechanical	2
Charleston	1	Throop Polytechnic Institute	3
Colby	1	U.S. Naval Academy	17
Colegio El Parvenir	1	Virginia Military Institute	1
Cooper Union Night School of Science	1	Washington and Jefferson	3
Dalhousie	2	Williams	6
Earlham	1	Wittenberg	1
Franklin and Marshall	1	Worcester Polytechnic Institute	1
Hamilton	1	Graduates of Colleges	113
Hampden-Sidney	1	Graduates of Universities	93
Immaculate Conception	1		206
Iowa	1	Double count	6
Iowa State	2	Total	200
Japanese Naval Engineering	1		
Kansas State Agricultural	1		

WOMEN STUDENTS.

The number of women pursuing courses with us is thirteen. Of these one is a college graduate. Of the total number one is a regular student of the fourth year, and five are of the second year. Seven are special students. Of the six regular students of the upper classes four take Course IV., Architecture; and two, Course V., Chemistry. Of the special students, four devote themselves to Architecture, one to Geology, while two are first-year students.

AGES OF STUDENTS.

The next table exhibits the ages of our students upon entrance, after taking out two who are repeating the first year, and seven persons of unusual ages. These deductions leave two hundred sixty-three as the number of students whose ages have been made the subject of computation.

Period of Life.	1905–1906.		1906–1907.	
	Half-year Groups.	Yearly Groups.	Half-year Groups.	Yearly Groups.
16 to 16½ years	1	—	—	—
16½ to 17 "	4	5	5	5
17 to 17½ "	13	—	14	—
17½ to 18 "	28	41	29	43
18 to 18½ "	42	—	51	—
18½ to 19 "	34	76	49	100
19 to 19½ "	30	—	51	—
19½ to 20 "	23	53	33	84
20 to 20½ "	14	—	12	—
20½ to 21 "	6	20	11	23
21 to 22 "	7	7	8	8
	202	202	263	263

The results appear in the table above in comparison with the corresponding results of 1905–06.

From the foregoing it appears that the average age on entrance is eighteen years and ten months.

In this connection are presented the ages, at graduation, of the class which left us in June. The two hundred seventy-eight members of the class were distributed among the different periods of life as follows:—

Under 20½	3
Between 20½ and 21	28
" 21 " 21½	20
" 21½ " 22	40
" 22 " 23	72
" 23 " 24	43
" 24 " 25	29
" 25 " 26	22
26 and over	21
Total	278

The average age was twenty-two years and nine months.

STATISTICS OF ADMISSION.

Of the 1,397 students of the present year, 535 were not connected with the school in 1905–06. Of these 248 were admitted as regular students of the first year upon the basis of their entrance examinations. The 287 remaining comprise (1) those who had previously been connected with the Institute, and have resumed their places in the school; (2) those who were admitted provisionally without examinations; (3) those who were admitted by examination as regular second year or as special students; (4) those who were admitted on the presentation of diplomas or certificates from other institutions of college grade. In addition to the 248 who were thus admitted to the first year on examination, and have taken their place in the school, 63 were admitted on examination, but have not entered the school.

In the case of the 271 persons who were admitted on examination, and have joined the school as regular students or as special students, the results of the examinations, embracing both those of June and those of September, were as follows:—

	Regulars.	*Specials.*
Admitted clear	159	7
" on one condition	52	7
" on two conditions	30	3
" on three conditions	7	6
	248	23

Of the 685 persons who presented themselves in June for examination, 19 Complete, 8 Final, 92 Preliminary, and 15 Partial candidates, a total of 134, were rejected. In September 17 Complete, 10 Final, and 17 Preliminary candidates were rejected. 292 candidates, including those for advanced standing, attended the September examinations.

92 college entrance examination board certificates were submitted.

STATISTICS OF GRADUATION.

Table to show the number of years spent at the Institute by students graduated with the class of 1906.

Total number of degrees of Bachelor of Science awarded June, 1906, 277.

Number receiving degree at end of 3d year	1
" " " " " " 4th "	190
" " " " " " 5th "	36
" " " " " " 6th "	2
Number entering from other colleges	48
	277

Of the college men 30 were graduates and 18 non-graduates.

STUDENTS FROM OTHER COLLEGES.

Yrs. at the Inst.	*Graduate*	*Non-graduate*	*Total*
1	3	0	3
2	14	6	20
3	8	7	15
4	3	3	6
5	2	2	4
	30	18	48

RESIDENCE OF STUDENTS.

The following tables show in detail and for the school as a whole the residence of students for the current year and for the last five years.

A TABLE TO SHOW THE NUMBER OF STUDENTS IN EACH YEAR, FROM 1900, COMING FROM EACH STATE OR TERRITORY.

STATES AND TERRITORIES.	1900.	1901.	1902.	1903.	1904.	1905.	1906.
North Atlantic.							
Connecticut	35	42	43	44	48	50	36
Maine	22	30	35	34	26	22	18
Massachusetts	779	837	935	869	889	807	764
New Hampshire	26	31	34	23	36	32	26
New Jersey	8	6	8	13	16	11	15
New York	68	79	96	104	94	71	84
Pennsylvania	37	36	44	52	56	58	55
Rhode Island	35	38	40	28	19	24	23
Vermont	15	15	12	11	5	5	4
Total	1,025	1,114	1,247	1,178	1,189	1,080	1,025
South Atlantic.							
Delaware	4	3	4	3	2	1	2
Dist. of Columbia	13	14	17	15	17	13	12
Florida	1	1	2	2	4	3	3
Georgia	3	4	6	4	6	8	4
Maryland	13	16	27	25	18	19	17
North Carolina	2	6	6	7	1	–	1
South Carolina	1	2	4	–	–	1	3
Virginia	3	5	7	7	4	7	8
West Virginia	1	1	–	–	–	1	2
Total	41	52	73	63	52	53	52
South Central.							
Alabama	1	2	1	1	1	1	2
Arkansas	1	1	1	1	–	1	–
Kentucky	5	9	11	9	8	5	5
Louisiana	2	1	2	2	5	1	2
Mississippi	–	–	–	4	4	4	5
Tennessee	6	4	3	5	2	2	3
Texas	4	7	9	11	13	16	15
Total	19	24	27	33	33	30	32
North Central.							
Illinois	39	44	49	44	43	42	37
Indiana	7	11	14	6	10	10	15
Iowa	10	8	8	6	9	13	14
Kansas	–	1	1	1	4	7	6
Michigan	8	12	10	9	9	10	7
Minnesota	7	10	10	9	11	13	14
Missouri	13	19	20	22	25	29	17
Nebraska	4	3	5	4	5	4	2
North Dakota	–	–	1	1	1	–	3
Ohio	27	27	43	37	35	34	30
South Dakota	1	2	1	3	2	–	1
Wisconsin	8	11	11	13	14	12	7
Total	124	148	173	155	168	174	153
Western.							
California	10	9	15	19	18	23	21
Colorado	8	6	10	11	16	17	12
Idaho	–	1	–	–	–	–	–
Montana	5	4	3	2	5	3	3
Nevada	1	–	–	–	–	1	1
New Mexico	–	–	1	1	2	–	–
Oregon	1	2	4	7	8	5	2
Utah	7	7	2	3	3	2	3
Washington	2	4	3	3	2	2	5
Wyoming	–	–	1	–	–	2	5
Total	34	33	39	46	54	55	52

States and Territories.	1900.	1901.	1902.	1903.	1904.	1905.	1906.
Hawaii	1	–	–	1	1	1	2
Philippine Islands	–	–	–	–	4	2	3
Porto Rico	–	1	2	2	4	5	2
Total	1	1	2	3	9	8	7
Total for the United States	1,244	1,372	1,561	1,478	1,505	1,400	1,321

A Table to show the Number of Students in Each Year, from 1900, coming from Each Foreign Country.

Foreign Countries.	1900.	1901.	1902.	1903.	1904.	1905.	1906.
Argentine Republic	–	–	–	–	–	–	1
Armenia	–	–	–	1	1	3	2
Australia	–	–	2	3	1	3	3
Austria	–	1	–	–	–	–	–
Belgium	–	–	–	–	–	–	1
Bermuda	1	2	1	1	–	1	1
Brazil	–	4	5	3	3	1	–
British Columbia	–	–	–	–	–	1	1
Cape Colony	–	–	–	–	–	–	1
Central America	–	–	–	–	1	–	–
Chili	–	1	1	1	1	2	1
China	–	1	1	2	8	8	7
Cuba	–	1	2	3	4	4	4
Denmark	1	1	1	1	1	1	1
Ecuador	–	–	–	–	1	–	2
Egypt	–	–	–	–	–	1	2
England	3	3	3	4	4	5	6
France	4	1	–	–	1	1	–
Germany	2	3	1	2	–	–	–
Honduras	–	–	–	–	–	–	1
India	–	–	–	1	1	2	1
Ireland	–	–	1	1	–	2	2
Italy	–	–	–	–	–	2	–
Jamaica	1	1	–	–	1	–	1
Japan	2	2	1	2	1	3	5
Korea	–	–	–	–	2	–	–
Malta, Island of	–	–	–	1	1	–	–
Manitoba	–	–	1	1	–	–	–
Mexico	7	7	10	8	4	7	12
New Brunswick	2	2	2	1	2	4	3
Nova Scotia	2	6	8	9	4	1	4
Ontario	–	3	2	2	5	6	6
Peru	–	–	–	–	–	1	1
Quebec	4	2	–	1	2	1	1
Russia	1	1	–	–	–	–	–
Scotland	–	–	1	1	2	1	1
Sweden	–	–	–	–	1	–	–
Syria	–	–	–	1	1	–	–
Transvaal	–	–	–	–	1	3	3
Turkey	3	1	4	–	2	1	1
Uruguay	–	–	–	–	–	2	1
Total	33	43	47	50	56	66	76
Total in school	1,277	1,415	1,608	1,528	1,561	1,466	1,397

RESIDENCE OF STUDENTS FOR THIS SCHOOL YEAR.

States.	Candidates for Advanced Degrees.	Fourth Year.	Third Year.	Second Year.	First Year.	All Regular Students.	Special Students.	Total.
Alabama	–	–	1	1	–	2	–	2
California	–	3	2	1	2	8	13	21
Colorado	1	2	2	2	1	8	4	12
Connecticut	–	6	7	5	2	20	16	36
Delaware	1	–	–	1	–	2	–	2
D st. of Columbia	2	2	–	–	3	7	5	12
Florida	–	–	1	–	1	2	1	3
Georgia	–	1	–	–	–	1	3	4
Hawaii	–	–	–	1	–	1	1	2
Illinois	–	6	1	5	6	18	19	37
Indiana	2	2	1	4	1	10	5	15
Iowa	–	2	2	2	1	7	7	14
Kansas	–	1	1	–	–	2	4	6
Kentucky	–	1	–	–	–	1	4	5
Louisiana	–	–	–	–	–	–	2	2
Maine	–	2	4	3	4	13	5	18
Maryland	1	4	2	1	–	8	9	17
Massachusetts	13	91	121	105	187	517	247	764
Michigan	–	1	–	–	2	3	4	7
Minnesota	–	4	1	–	–	5	9	14
Mississippi	–	3	–	1	–	4	1	5
Missouri	–	2	1	3	–	6	11	17
Montana	–	–	1	–	1	2	1	3
Nebraska	–	–	1	–	–	1	1	2
Nevada	–	–	–	–	–	–	1	1
New Hampshire	1	3	4	2	9	17	9	26
New Jersey	1	1	4	2	3	11	4	15
New York	1	13	9	7	20	50	34	84
North Carolina	–	–	–	–	1	1	–	1
North Dakota	–	–	–	–	2	2	1	3
Ohio	3	5	3	1	2	15	15	30
Oregon	–	–	–	–	1	1	1	2
Pennsylvania	2	8	9	4	7	30	25	55
Philippine Islands	–	–	–	–	–	–	3	3
Porto Rico	–	–	–	–	–	–	2	2
Rhode Island	–	2	3	4	2	11	12	23
South Carolina	–	–	–	1	–	1	2	3
South Dakota	–	–	1	–	2	1	–	1
Tennessee	1	–	–	–	–	1	2	3
Texas	1	4	1	3	1	10	5	15
Utah	–	–	–	–	1	1	2	3
Vermont	–	–	–	–	2	2	2	4
Virginia	–	1	1	1	2	5	3	8
Washington	–	–	–	–	1	1	4	5
West Virginia	–	1	–	–	–	1	1	2
Wisconsin	1	2	1	–	1	5	2	7
Wyoming	–	–	–	–	–	–	5	5
Foreign Countries.								
Argentine Repub.	–	–	–	–	1	–	1	1
Armenia	–	1	–	1	–	2	–	2
Australia	–	–	–	–	–	2	1	3
Belgium	–	–	–	–	–	–	1	1
Bermuda	–	–	–	–	–	–	1	1
British Columbia	–	–	–	–	–	–	1	1
Cape Town	–	–	–	1	–	1	–	1
Chile	–	–	–	1	–	1	–	1
China	–	–	–	–	–	–	7	7
Cuba	–	2	–	–	–	2	2	4
Denmark	–	–	1	–	–	1	–	1
Ecuador	–	–	–	–	1	1	1	2
Egypt	–	–	–	–	–	–	2	2
England	–	2	1	2	–	5	1	6
Honduras	–	–	–	–	1	1	–	1
India	–	–	–	–	–	–	1	1
Ireland	–	–	–	–	1	1	1	2
Jamaica	–	–	–	–	1	1	–	1
Japan	–	–	–	–	–	–	5	5
Mexico	–	–	2	1	3	6	6	12
New Brunswick	–	–	–	–	–	–	3	3
Nova Scotia	1	–	1	1	–	3	1	4
Ontario	–	–	–	2	–	2	4	6
Peru	–	–	–	–	–	–	1	1
Quebec	–	–	1	–	–	1	–	1
Scotland	–	–	1	–	–	1	–	1
Transvaal	–	–	–	–	–	–	3	3
Turkey	–	–	–	–	–	–	1	1
Uruguay	–	–	–	–	–	–	1	1
Total	32	178	194	169	272	845	552	1,397

RESIDENCE OF MASSACHUSETTS STUDENTS.

(1) From Counties.

County.	No. of Towns.	No. of Students.	County.	No. of Towns.	No. of Students.
Barnstable	2	4	Hampshire	2	2
Berkshire	6	21	Middlesex	34	230
Bristol	9	29	Norfolk	21	91
Dukes	1	3	Plymouth	13	29
Essex	22	98	Suffolk	4	219
Franklin	3	4	Worcester	10	16
Hampden	3	18	Total	130	764

(2) From Cities which send Five or More Students.

Boston	203	Salem	11	Pittsfield	7
Newton	49	Springfield	11	Abington	6
Brookline	33	Taunton	11	Melrose	6
Cambridge	22	Wakefield	10	North Adams	6
Somerville	21	Gloucester	9	Reading	6
Malden	19	Haverhill	9	Adams	5
Lowell	15	Lynn	9	Natick	5
Newburyport	15	Quincy	8	New Bedford	5
Waltham	15	Wellesley	8	Peabody	5
Lawrence	13	Chelsea	7	Revere	5
Hyde Park	12	Medford	7		

SUMMER SCHOOL.

Table showing the Number of Students registered in Each of the Courses of the Summer School for this Year and the Year before.

	1905	1906
Air, Water and Food Analysis	0	4
Analytic Geometry	30	20
Applied Mechanics	24	19
Bacteriology	2	0
Carpentry and Wood Turning	8	4
Chemistry, Inorganic and Analytical	42	39
Chipping and Filing	3	9
Descriptive Geometry	36	35
Design	6	9
Forging	10	16
French	14	9
German	19	10
Integral Calculus	12	14
Machine-Tool Work	26	27
Mechanical Drawing	19	21
Mechanical Engineering Drawing	9	19
Mechanism	6	18
Metal Turning	0	1
Pattern Work	9	3
Physical Laboratory	15	10
Physics	43	39
Precision of Measurements	0	6
Shades and Shadows	5	1
Surveying	27	14

ADDITIONAL STATISTICS.

	1905	1906
Number from other colleges and schools attending	46	39
Number not referring to any other college or school	8	4
Number from Massachusetts Institute of Technology	218	186
		229
Number who registered, but did not attend	13	14
Number who applied, but cancelled registration	10	2

FROM OTHER COLLEGES AND SCHOOLS.

Bucknell University	1
Harvard University	6
Johns Hopkins University	1
Princeton University	1
Purdue University	1
Union University	1
Washington University	1
Yale University	1
University of Chicago	1
University of Michigan	1
University of Mississippi	1
University of Texas	1
Amherst College	1
Bates College	2
Bowdoin College	1
Dalhousie College	1
Hampden-Sidney College	1
Wellesley College	1
Woodstock College	2
Worcester Polytechnic Institute	2
1 each from District School, Adamsville, Que., Groveland High School, Lynn English High School, Massachusetts Normal Art School, Millis High School, New York Technical School, Norfolk Academy, Oswego Normal School, Parrsboro High School, Peekskill Military Academy, and Portland High School	
	39

FROM MASSACHUSETTS INSTITUTE OF TECHNOLOGY.

	1905	1906
Number of subjects taken to make up failures or deficiencies	196	166
Number of subjects taken to anticipate work	149	220

WALTER HUMPHREYS, *Registrar.*

The Society of Arts.

To the President of the Massachusetts Institute of Technology:

Sir,—On behalf of the Executive Committee I have the honor to present the annual report of the Society of Arts for the year ending May 10, 1906.

The first meeting of the Society for the present year was held on October 12, 1905. Thirteen meetings have been held, with an average attendance of one hundred and seven. The interest manifest in the Society for several years has been continued during the past year, not only by the members, but by the public at large and by many of the students of the Institute, the attendance of the latter when papers of technical interest have been presented being especially gratifying. The range of subjects presented has been a wide one, and as a consequence nearly all the students have had the opportunity to hear a paper on some subject of professional interest.

The following papers have been read:—

The Disposal of City Sewage, by Professor Charles-Edward A. Winslow, Biologist in charge of the Sanitary Research Laboratory and Sewage Experiment Station.

Browntail and Gypsy Moths, their Life Histories, and Some Suggestions for their Suppression, by Mr. William Lyman Underwood.

Submarine Signalling, by Mr. Henry R. Gilson.

Recent Researches on the Canals of Mars, by Professor Percival Lowell, Director of the Astronomical Observatory at Flagstaff, Arizona.

The Treatment of the Black Sands of the Pacific Coast by the United States Geological Survey, by Professor Robert H. Richards, of the Institute.

The American Indian Folklore, by Professor Alexander F. Chamberlain, of Clark University.

Hydraulic Mining in British Columbia and Alaska, by Mr. Howard W. Du Bois, Mining Engineer of Philadelphia.

Causes and Effects of River Capture, by Professor Douglas W. Johnson, of the Institute.

Shoddy, or the History of a Woolen Rag, by Mr. Henry G. Kittredge, Editor of the *Textile American*.

The Chemistry of Cellulose as Applied to Textile Fibres, Mercerized Cotton, Artificial Silk, and Horse Hair, by Professor William H. Walker, of the Institute.

The American Bison: Our Grandest Native Animal, by Mr. Ernest Harold Baynes.

The Rationale of the Industrial Betterment Movement, by Mr. H. F. J. Porter, of New York.

Practical Operation of a Dynamometer Car in Establishing Locomotive Tonnage Rating, by Mr. Herbert O. Keay.

The membership of the Society has remained practically the same as last year. Fifteen members have resigned, two have died, and two have not been heard from, and the number of new members elected to associate membership has been fourteen, leaving the total membership three hundred and fifty-eight. The *Technology Quarterly* has continued to be published under the editorship of Dr. Robert P. Bigelow, with the advice and counsel of the Publication Committee of the Society. In addition to the Proceedings of the Society twenty-five papers and twenty-five book reviews have been published. Among the papers published the following were of special interest:—

Modern Language Teaching, with Special Reference to Pronunciation and Conversation, by Professor John Bigelow, Jr.

The Cruiser, and The Sea-going Battleship, by Professor William Hovgaard.

Submarine Signalling, by Mr. Henry R. Gilson.

Railway Telephone Service, the Cost of Line Construction, by Mr. F. F. Fowle.

Orientation of Buildings and Streets in Relation to Sunlight, by Mr. William Atkinson.

The different departments of the Institute have contributed papers as follows: The Biological Department, four papers; the Chemical Department, three papers; the Electrical Engineering Department, two papers; the Geological Department,

two papers; the Naval Architecture Department, two papers; the Modern Languages Department, one paper.

At the forty-fourth annual meeting of the Society, held on May 10, 1906, the following officers were elected:—

Executive Committee.—George W. Blodgett, James P. Munroe, Edmund H. Hewins, James F. Norris, C. J. H. Woodbury.

Secretary.—Walter S. Leland.

Board of Publication.—William T. Sedgwick, Dwight Porter, Harry E. Clifford, Robert P. Bigelow, Dana P. Bartlett.

Respectfully submitted,

WALTER S. LELAND, *Secretary.*

Publications.

CIVIL ENGINEERING.

G. F. SWAIN.—Report to the Massachusetts Railroad Commissioners on Steam Railroad and Street Railway Bridges in Massachusetts. In *Report of Railroad Commissioners*, 1905.

G. F. SWAIN.—Report to the Massachusetts Railroad Commissioners on Steam Railroad and Street Railway Bridges in Massachusetts. In *Report of Railroad Commissioners*, 1906.

G. F. SWAIN.—What is the Best Preparatory Education for the Civil Engineering Profession? *Transactions of the American Society of Civil Engineers*, 1906.

G. F. SWAIN.—Technical Training the Best Education for Executive Work. *Transactions of the American Society of Civil Engineers*, 1906.

F. P. MCKIBBEN.—Parts of "Concrete Plain and Reinforced," by Taylor and Thompson, New York. Wiley & Sons, 1905.

F. P. MCKIBBEN.—Distribution of Loads on Stringers of Highway Bridges carrying Electric Cars. *Engineering News*, April 12, 1906.

F. P. MCKIBBEN.—Tension Tests on Steel Angles with Various Types of End Connections. Read before the American Society for Testing Materials, June, 1906. *Engineering News*, July 5, 1906.

C. B. BREED and G. L. HOSMER.—The Principles and Practice of Surveying. New York, Wiley & Sons, 1906.

MECHANICAL ENGINEERING.

G. LANZA.—Memoirs of Deceased American Investigators who have contributed to the Advance of the Testing of Materials. *Proceedings of the American Society for Testing Materials*, 1906.

G. LANZA.—Report of Committee on Standard Methods of Tests. *Proceedings of the American Society for Testing Materials*, 1906.

G. LANZA.—Tests of Re-enforced Concrete Beams. *Proceedings of the American Society for Testing Materials*, 1906.

E. F. MILLER.—Notes on Power Station Design. Published by the Institute.

C. F. PARK.—The Testing of Shock Absorbers. *Horseless Age*, Nov. 7, 1906.

MINING ENGINEERING AND METALLURGY.

R. H. RICHARDS.—Progress in Gold Milling in 1905. *The Mineral Industry*, Vol. XV., p. 289.

R. H. RICHARDS. Progress in Ore Dressing and Coal Washing in 1905. *The Mineral Industry*, Vol. XV., p. 685.

H. O. HOFMAN.—Recent Improvements in Lead Smelting. *The Mineral Industry*, Vol. XV., p. 388.

H. O. HOFMAN.—Improvements in Sampling and Assaying. *The Mineral Industry*, Vol. XV., p. 647.

H. O. HOFMAN (with R. HAYDEN and H. B. HALLOWELL). – A Study in Refining and Overpoling Electrolytic Copper. *Transactions of the American Institute of Mining Engineers*, Vol. XXXVI., 1906.

H. O. HOFMAN (with R. G. REYNOLDS and A. E. WELLS). – Lime Roasting a Galena Concentrate with Special Reference to the Savelsberg Process. *Transactions of the American Institute of Mining Engineers*, Vol. XXXVI., 1906.

H. O. HOFMAN (with U. S. CAYPLESS and E. E. HARRING-

TON).—The Constitution of Ferro-cuprous Sulphides. *Transactions of the American Institute of Mining Engineers*, Vol. XXXVI., 1906.

H. O. HOFMAN.—Review of Vol. I. of Henry Louis' translation of the Handbook of Metallurgy by C. Schnabel. *American Chemical Journal*, Vol. XXXV., p. 473.

CHEMISTRY AND CHEMICAL ENGINEERING.

H. P. TALBOT.—Technical Chemistry in Technical Schools. *Technology Quarterly*, Vol. XIX., p. 83.

H. P. TALBOT.—The Training of a Chemical Engineer. *Proceedings of the Society for the Promotion of Engineering Education*, 1906.

H. P. TALBOT.—See A. G. Woodman.

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W. H. WALKER.—Some Present Problems in Technical Chemistry. *Congress of Arts and Sciences*, St. Louis Exposition, 1904, Vol. VI., p. 686.

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GENERAL STATEMENT

OF THE

RECEIPTS AND DISBURSEMENTS

BY THE TREASURER

FOR THE YEAR ENDING SEPT. 29, 1906

GENERAL STATEMENT

OF THE

RECEIPTS AND DISBURSEMENTS

BY THE TREASURER

FOR THE YEAR ENDING SEPT. 29, 1906

STATEMENT OF THE TREASURER.

The Treasurer submits the annual statement of the financial affairs of the Institute for the year ending Sept. 29, 1906.

Substantial savings have been effected in various items of expenditure, notably in those for fuel, water, gas, and electricity. The charts at the end of this report will show in the matter of electrical work a striking increase of power with decrease of cost. Less has been spent for the publication of notes, and in the matter of general expenses there would be a decided saving were it not for certain large and unusual expenditures.

Important changes and improvements have been made in the mechanical laboratories and in the architectural department, and the Rogers Building has been put in good condition. The final payments on the new gymnasium have been made, and the building has proved satisfactory and well suited to the purposes for which it is intended. The report of the Engineer shows that in his department our plant is in good condition, although some expenditures will have to be made before very long.

There has been an increase in expenses and a decrease in receipts from students' fees and the net result, comparing current expenditures with current receipts, is a deficit of $3,896.21. In this account is taken of one of the most interesting features of the year, namely, the results of the devoted and efficient work of the Income Committee. This Committee has paid over to the Institute during the year $42,583.61 free from all conditions. The collection of this sum shows the good will of the alumni, as well as the good work of the Committee.

Apart from the above the Institute has received through the generosity of Mr. Nathaniel Thayer $25,000, to be added to the permanent endowment fund. A similar amount has been received from the executors of the will of the late Charles Choate, and a like sum from the executors of the will of the late Macy S. Pope.

Charles G. Weld, M.D., has generously given $15,000 to be added to the permanent endowment fund, and in addition to this has given $1,600 for the Department of Naval Architecture.

From the same generous but anonymous donor, who has contributed a like amount in previous years, we have received $5,000 for the Sanitary Research Fund.

Dr. A. A. Noyes has given $3,000 for the Physico-Chemical Research Laboratory.

Dr. W. W. Jaques, $1,000 for the Department of Physics.

The estate of the late William E. Hale has contributed $1,000 for the Physico-Chemical Fund.

Mrs. William B. Rogers has again given $225 for the purchase of periodicals for the Library.

From the estate of the late Ednah D. Cheney we have received a further payment of $180.

From the B. F. Sturtevant Co. a motor of the value of $150, and from Prof. Henry M. Howe $100.

The net result of the whole year is an addition to the property of the Institute of $86,865.85.

The Walker Memorial Fund now amounts to $107,557.06.

Securities Sold or Paid, General Fund.

$1,000	Bur. & Miss. River non-ex 6s	1918	$1,000.00
65 000	Boston & Maine R.R. 4½s	1944	74;181.25
5,000	Ozark Equipment Co. 5s	1910	5,000.00
50	Sh. Union Pacific R.R. pref.		4,886.50
80	Rights Ch., Mil. & St. Paul R.R. pref.		1,430.00
			$86,497.75

Securities Sold or Paid, Rogers Fund.

600	Republican Valley R.R. 6s	1919	600.00

Securities Bought or Received as Legacies, General Fund.

20,000	American Tel. & Tel. Notes 5½s	1907	20,000.00
20,000	Louisville & Nashville 4s	1923	19,750.00
25,000	Mass. Electric Co. Notes 4½s	1910	24,500.00
75,000	Lake Shore & Mich. So. R.R. deb. 4s	1931	75,000.00
5,000	Wabash Equipment 4½s	1907	5,000.00
25,000	Wabash Equipment 4½s	1912	24,360.00
			$168,610.00

Securities Bought, Rogers Fund.

1,000	Wabash Equipment 4½s	1916	$961.00

Gifts and Bequests for Special Purposes.

Increase Scholarship Funds		2,799.82	
" Austin Fund		410.00	
" Teachers' Fund		2,470.00	
Ednah Dow Cheney Fund, additional		180.00	
Susan E. Dorr Fund, additional		684.06	
Charles Choate Fund		25,000.00	31,543.88

Gifts and Bequests for General Purposes.

Nathaniel Thayer Fund		25,000.00	
Macy S. Pope Legacy		25,000.00	
Thomas Gaffield Legacy		43.18	50,043.18

GEORGE WIGGLESWORTH, TREASURER, *in account with*
GENERAL STATEMENT OF RECEIPTS AND DISBURSEMENTS

Dr.

Cash balance, Sept. 30, 1905		$23,215.40
RECEIPTS FOR CURRENT EXPENSES.		
Income for funds for salaries	4,324.00	
" " " " Fellowships	1,400.00	
" " " " scholarships (students' fees)	10,175.00	
" " " " Joy "	100.00	
" " " " W. B. Rogers Scholarships	625.00	
" " " " Library	480.00	
" " " " general purposes	26,438.67	
" " Rogers Memorial Fund	10,845.75	
" " Charlotte B. Richardson Fund	1,495.15	
" " Rotch Prize Funds	400.00	
" " Rotch Architectural Fund	1,000.00	
" " Edward Austin Fund, Scholarships	8,577.50	
" " " " " Awards	5,312.50	
" " Teachers' Fund	1,530.00	
" " Ednah Dow Cheney Fund	448.43	
Students' fees	313,816.25	
State Scholarships	4,000.00	
United States Act of 1862	5,306.68	
United States Act of 1890	8,333.34	
Gift of State of Massachusetts	25,000.00	
Laboratory supplies and breakages	11,936.36	
Rents, per Table (page 12)	10,757.68	
Gifts	1,825.00	
Interest	4,176.04	
Sale Printed Lecture Notes	3,624.04	
Income Fund Committee	42,583.61	504,511.00
GIFTS AND BEQUESTS FOR SPECIAL PURPOSES. (Page 3)		31,543.88
GIFTS AND BEQUESTS FOR GENERAL PURPOSES. (Page 3)		50,043.18
SECURITIES SOLD OR PAID.		
General Fund, page 3	86,497.75	
Rogers Fund, page 3	600.00	87,097.75
SUNDRIES.		
Income credited to Bond Premium Acc't	4,199.25	
" " " Rogers Bond Premium Acc't	636.00	
Copley Society of Boston, on acc't	666.67	
Walker Memorial Fund	4,075.00	
Naval Architecture Fund	1,667.13	
Letter Box Fund	37.25	
Sanitary Research Laboratory Fund, additional	5,000.00	
Physico-Chem. Research Fund	4,000.00	
Students' Notes	125.00	
Students' Fees paid in advance, Increase %	99,327.50	
Students' Deposits " " "	8,850.00	
Accounts Payable	5,973.23	134,557.03
		$830,968.24

MASSACHUSETTS INSTITUTE OF TECHNOLOGY.
FOR THE YEAR ENDING SEPT. 29, 1906.

Cr.

EXPENSES.

Salaries, per Table (page 12)	$368,504.55	
Fellowship paid from Savage Fund	650.00	
" " " Dalton Grad. Chem. Fund	200.00	
" " " Swett Fund	150.00	
" " " H. Saltonstall Fund	400.00	
Edward Austin Fund, Awards	5,312.50	
Teachers' Fund "	1,530.00	
Prizes, Rotch Funds	400.00	
Repairs to Buildings, per Table (page 13)	16,843.91	
General Expenses, per Table (page 13)	14,261.99	
Fire Insurance	2,919.26	
Fuel	15,413.96	
Water	3,014.40	
Gas	2,394.24	
Electricity	425.67	
Printing and Advertising	5,768.41	
" Lecture Notes	2,215.32	
" Annual Catalogues and Reports	4,311.44	
Physico-Chemical Research Fund	3,000.00	
Department Supplies and Repairs, per Table (page 12)	58,853.69	
Society of Arts	1,389.44	
Margaret Cheney Reading Room	448.43	508,407.21

(Expenses more than Income, $3,896.21.)

SECURITIES BOUGHT OR RECEIVED AS LEGACIES.

General Fund, page 3	168,610.00	
Rogers Fund, page 3	961.00	169,571.00

SUNDRIES.

Cabot Medal Fund	8.03	
Naval Architecture Fund	1,330.83	
Sanitary Research Laboratory Fund	6,267.84	
Physico-Chem. Research Fund	3,464.93	
Dormitory Fund	696.94	
Walker Memorial Fund	12,246.20	
New Gymnasium	8,650.17	
Supplies Acc't.	1,459.30	34,124.24
Cash balance, Sept. 29, 1906		118,865.79
		$830,968.24

E. and O. E.

GEORGE WIGGLESWORTH,
Treasurer.

The following account exhibits the property held by the Institute, as per Treasurer's books, Sept. 29, 1906:—

INVESTMENT OF THE W. B. ROGERS MEMORIAL FUND.

31,000.00	N.Y. Central & H. R. R.R. Deb. 4s,	1934	30,225.00	
6,000.00	Baltimore & Ohio R.R. 3½s . . .	1925	5,310.00	
27,000.00	Kansas City Belt R.R. 6s	1916	27,000.00	
3,200.00	Republican Valley R.R. 6s	1919	3,200.00	
4,000.00	Cin.,Ind.,St. Louis & Chicago R.R.6s,	1920	4,000.00	
4,000.00	Kansas City,Fort Scott & Gulf R.R.7s	1908	4,000.00	
1,000.00	Lincoln & Northwestern R.R. 7s .	1910	1,000.00	
1,000.00	Atchison & Nebraska R.R. 7s . .	1908	1,000.00	
35,000.00	Fort Street Union Depot 4½s . . .	1941	34,825.00	
24,000.00	Rome, Watertown & Ogdensburg R.R. 5s	1922	24,000.00	
37,500.00	Detroit, G. Rapids & Western R.R.4s,	1946	37,500.00	
25,000.00	Atchison, Top. & St. Fé R.R. 4s .	1995	24,470.00	
7,000.00	Chesapeake & Ohio R.R. 5s . . .	1939	7,000.00	
38,000.00	Chi. Junc. & Union Stock Yards 5s	1915	38,000.00	
1,000.00	Wabash Equipment 4½s	1916	961.00	
	Advances to Bond Premium acc't .		6,107.00	
				248,598.00

INVESTMENTS, GENERAL ACCOUNT.

5,000.00	Bur. & Mo. River (Neb.) R.R. 6s, non-ex.	1918	5,000.00	
2,000.00	Bur. & Mo. River (Neb.) R.R. 6s, exempt	1918	2,000.00	
5,000.00	Chicago, Burlington & Quincy R.R.4s	1922	4,100.00	
3,000.00	Hannibal & St. Joseph R.R. 6s . .	1911	3,000.00	
26,000.00	Am. Dock & Improvement Co. 5s .	1921	26,000.00	
3,000.00	Illinois Central R.R. 4s	1951	3,000.00	
8,000.00	Chi. Junc. & Union S. Yards 5s .	1915	8,000.00	
2,000.00	New England Tel. & Tel. Co. 6s	1907–8	2,000.00	
100,000.00	West End Street Ry. 4s	1917	100,000.00	
50,000.00	Utah & Northern R.R. 1st 7s . . .	1908	50,000.00	
120,000.00	Illinois Steel Co., non-conv. 5s . .	1913	119,586.25	
43,000.00	Chesapeake & Ohio R.R. 5s . . .	1939	43,000.00	
100,000.00	Long Island R.R. 4s	1949	96,137.50	
7,000.00	K. C., Clinton & Springfield R.R. 5s,	1925	6,289.21	
8,500.00	K. C., Mem. & Birmingham R.R. 4s,	1934	8,287.50	
13,000 00	K.C., St. Jo. & Council Bluffs R.R. 7s,	1907	13,000.00	
50,000.00	Kansas City Stock Yards 5s . . .	1910	50,000.00	
25,000.00	Atchison, Top. & St. Fé R.R. 4s. .	1995	25,000.00	
50,000.00	Rio Grande & Western R.R. 4s . .	1939	49,180.00	
50,000.00	Oregon R.R. & Navigation Co. 4s,	1946	50,000.00	
50,000.00	Union Pacific R.R. 4s	1947	50,000.00	
100,000.00	Chi. & W. Michigan R.R. 5s . .	1921	100,000.00	
105,000.00	American Tel. & Tel. Co. 4s . . .	1929	104,700.00	
50,000 00	New England Tel. & Tel. Co. 4s .	1930	50,000.00	
50,000.00	Chi. Junc. & Union S. Yards 4s .	1940	49,250.00	
50,000.00	K. C., Fort Scott & Memphis R.R.6s	1928	50,000.00	
25,000.00	Southern Ry., St. Louis Div. 4s . .	1951	24,875.00	
9,000.00	Ozark Equipment Co. 5s	1910	9,000.00	
50,000.00	Northern Pac. Gt. Northern Joint 4s,	1921	48,500.00	
34,000.00	Baltimore & Ohio R.R. 3½s . . .	1925	30,090.00	
30,000.00	Chi., Mil. & St. Paul R.R. 7s . . .	1910	30,000.00	
52,000.00	N.Y. Cent. & H. R. R.R.(L. S.) 3½s,	1998	46,046.65	
50,000.00	Oregon Short Line 4s	1929	48,500.00	
5,000.00	Terminal Asso. St. Louis 4s . . .	1953	5,000.00	
3,000.00	Lake Shore & Mich. Southern 4s .	1928	3,000.00	
	Advances to Bond Premium acc't .		29,405.00	
	Carried up		1,341,947.11	
	Amount carried up			$248,598.00

Amount brought up $248,598.00

INVESTMENTS, GENERAL ACCOUNT,—*Continued.*

	Brought up			1,341,947.11	
20,000.00	American Tel. & Tel. notes 5½s . .		1907	20,000.00	
20,000.00	Louisville & Nashville 4s		1923	19,750.00	
25,000.00	Mass. Electric Co. notes 4½s . . .		1910	24,500.00	
75,000.00	Lake Shore & Mich. So. deb. 4s .		1931	75,000.00	
5,000.00	Wabash Equipment 4½s (Notes) .		1907	5,000.00	
25,000.00	Wabash Equipment 4½s		1912	24,360.00	1,510,557.11

STOCKS.

Shares.					
172	Boston & Albany R.R.	par	100	34,456.50	
80	Chi., Milwaukee & St. Paul R.R. Pf.	"	100	8,478.00	
12	Cocheco Manufacturing Co.	"	500	6,000.00	
56	Hamilton Woolen Co.	"	100	5,390.00	
31	Great Falls Manufacturing Co.	"	100	3,472.00	
2	Dwight Manufacturing Co.	"	500	1,600.00	
17	Pepperell Manufacturing Co.	"	100	2,789.50	
27	Essex Co.	"	50	3,780.00	
64	Boston Real Estate Trust	"	1000	68,605.64	
1	Boston Ground Rent Trust	"	1000	900.00	135,471.64

INVESTMENT OF THE JOY SCHOLARSHIP FUND.

	Massachusetts Hospital Life Insurance Co. . . .	5,000.00	
	Deposits in Savings Banks	5,346.31	10,346.31

INVESTMENT SWETT SCHOLARSHIP FUND.

	Massachusetts Hospital Life Insurance Co.		10,000.00

INVESTMENT OF RUSSEL FELLOWSHIP FUND.

2,000.00	Conveyancers Title Ins. Co. Mortgage 4s	1908	2,000.00	
	Amount carried up			$1,916,973.06

Amount brought up		$1,916,973.06

REAL ESTATE.

Rogers Building		200,000.00	
Walker "		150,000.00	
Land on Garrison Street	50,840.00		
Mechanic Arts Building	30,000.00	80,840.00	
Land on Trinity Place	76,315.69		
Engineering Bldg. A, Trinity Place .	90,000.00	166,315.69	
Gymnasium Building		12,603.43	
Engineering Building, B		57,857.10	
Engineering Building, C		47,561.08	
Lot No. 2, Trinity Place		137,241.60	
Lot No. 3, " "		282,286.35	
Henry L. Pierce Building, Trinity Place		154,297.05	
Boiler and Power House, " "		26,916.74	
Clarendon St. Land and Building		142,762.94	
Real Estate, Massachusetts Ave., Cambridge . .		16,154.38	
Real Estate, Brookline, Mass.		112,964.32	
Aug. Lowell Lab. Elec. Eng. Bldg., 1902 . . .		121,790.93	1,709,591.61
Equipment, Engineering Building		16,555.24	
" Mechanical Laboratories		20,628.56	
" Elec. Eng. Building		87,282.24	124,466.04

SUNDRIES.

Notes Receivable	12,000.00	
Loans to Copley Society of Boston	6,333.32	
Students' Notes	570.50	
Cash balance, Sept. 29, 1906	118,865.79	137,769.61
		$3,888,800.32

The foregoing property represents the following Funds and Balances, and is answerable for the same.

The income of the following is used for the general purposes of the Institute:—

William Barton Rogers Memorial Fund	250,225.00	
Richard Perkins Fund	50,000.00	
George Bucknam Dorr Fund	49,573.47	
Martha Ann Edwards "	30,000.00	
Nathaniel C. Nash "	10,000.00	
Sidney Bartlett "	10,000.00	
Robert E. Rogers "	7,680.77	
Albion K. P. Welch "	5,000.00	
Stanton Blake "	5,000.00	
McGregor "	2,500.00	
Katharine B. Lowell "	5,000.00	
Samuel E. Sawyer "	4,764.40	
John W. and Belinda L. Randall Fund	83,452.36	
James Fund	163,654.21	
George Robert Armstrong Fund	5,000.00	
Arthur T. Lyman Fund	5,000.00	
Charles Choate Fund	25,000.00	
Nathaniel Thayer Fund	25,000.00	736,850.21
Amount carried up		$736,850.21

Amount brought up		$736,850.21
The income of the following is used towards paying salaries:—		
Nathaniel Thayer, for Professorship of Physics	25,000.00	
Jas. Hayward, for Professorship of Engineering	18,800.00	
William P. Mason, " " Geology	18,800.00	
Henry B. Rogers, for general salaries	25,000.00	
George A. Gardner, " "	20,000.00	
Sarah H. Forbes, salaries	500.00	108,100.00
SCHOLARSHIP TRUSTS.		
Richard Perkins Fund	53,398.15	
James Savage "	14,226.71	
Susan H. Swett "	10,582.95	
William Barton Rogers Fund	11,704.70	
Joy Fund	10,408.81	
Elisha Thatcher Loring Fund	5,416.78	
Charles Lewis Flint "	5,321.29	
Thomas Sherwin "	5,000.00	
Farnsworth "	5,000.00	
James H. Mirrlees "	2,884.06	
William F. Huntington "	5,263.59	
T. Sterry Hunt "	3,247.04	
Elisha Atkins "	5,000.00	
Nichols "	5,000.00	
Ann White Vose "	60,910.33	
Ann White Dickinson "	40,778.14	
Dalton Grad. Chemical "	5,768.65	
Willard B. Perkins "	7,196.05	
Billings Student "	50,000.00	
Henry Saltonstall "	10,000.00	
Isaac W. Danforth "	5,616.00	
Charles C. Nichols "	5,408.00	
Richard Lee Russel "	2,163.43	
Lucius Clapp "	5,096.00	335,390.68
OTHER TRUSTS.		
Charlotte Billings Richardson Ind. Chem. Fund,	37,378.78	
Susan Upham Fund	1,307.95	
Susan E. Dorr "	18,848.08	
William Hall Kerr Library Fund	2,000.00	
Charles Lewis Flint " "	5,000.00	
Rotch Architectural " "	5,000.00	
Rotch Architectural Fund	25,000.00	
Rotch Prize "	5,200.00	
Rotch "Special" Prize Fund	5,200.00	
Edward Austin "	376,886.72	
Teachers' "	108,870.00	
Saltonstall "	42,248.52	
Ednah Dow Cheney "	14,066.19	
Letter Box "	57.75	647,063.99
Aug. Lowell Lab. Electrical Eng. Fund		68,000.00
George B. Upton Legacy, 1905		5,000.00
Macy S. Pope Legacy, 1906		25,000.00
Thomas Gaffield Legacy, 1906		43.18
M. I. T. Stock Account		1,821,924.71
Amount carried up		$3,747,372.77

Amount brought up		$3,747,372.77
MISCELLANEOUS.		
Cabot Medal Fund	198.22	
Walker Memorial Fund	391.76	
Roentgen-Ray Experiment Fund	981.50	
Sanitary Research Laboratory Fund	1,585.73	
Dormitory Fund	1,997.26	
Physico-Chem. Research Fund	9.79	
Naval Architecture Fund	336.30	
Students' Fees received in advance	116,187.50	
Deposits for Breakages and Supplies	587.25	
Deposits for Breakages and Supplies received in advance	8,850.00	
Accounts Payable	10,302.24	141,427.55
		$3.888,800.32

COMPARATIVE STATEMENT OF FUNDS, ETC.

	Sept. 30, 1905.	Sept. 29, 1906.
Trusts for general purposes	686,850.21	736,850.21
" " Salaries	108,100.00	108,100.00
" " Scholarships	333,114.29	335,390.68
Other Trusts, per page 9	642,759.25	647,063.99
M. I. T. Stock Account	1,816,645.92	1,821,924.71
Aug. Lowell Lab. Electrical Eng. Fund	68,000.00	68,000.00
George B. Upton Legacy	5,000.00	5,000.00
Macy S. Pope Legacy		25,000.00
Thomas Gaffield Legacy		43.18
Miscellaneous, per page 10	38,534.04	141,427.55
	$3,699,003.71	$3,888,800.32

Increase,		
Consisting of:		
Bequests for Special Purposes, etc. (See page 3)	31,543.88	
Gifts and Bequests for General Purposes. (See page 3)	50,043.18	
Net gain on Bonds sold	9,175.00	90,762.06
Less Expenses more than Income		3,896.21
		$86,865.85
Increase in Miscellaneous		102,930.76

INCOME FROM GENERAL INVESTMENTS, AND APPLICATION THEREOF.

Applied to Salaries	4,324.00	From Bonds	64,597.82
" " Scholarships	10,800.00	" Dividends, Railroad Stocks	2,165.00
" " Fellowships	850.00	" " Manufacturing Stocks	1,580.00
" " Charlotte B. Richardson Fund	1,495.15	" Real Estate Stocks	2,915.00
" " Teachers' Fund	4,000.00		
" " Edward Austin Fund	14,400.00		
" " Rotch Prize Funds	400.00		
" " Rotch Architectural Fund	1,000.00		
" " Cheney Fund	551.33		
" " Library	480.00		
" " General Purposes	26,438.67		
" " Samuel Dorr Annuity	1,000.00		
" " Increase of Funds	1,319.42		
" " Advances to Bond Premiums	4,199.25		
	$71,257.82		$71 257.82

INCOME FROM WILLIAM BARTON ROGERS MEMORIAL FUND, AND APPLICATION THEREOF.

Paid Massachusetts Institute of Technology	10,845.75	Received Income from Railroad Bonds	11,481.75
Credited to Advances Bond Premiums	636.00		
	$11,481.75		$11,481.75

DETAILS OF SOME ITEMS IN TREASURER'S CASH ACCOUNT.

Rents.

Huntington Hall, for Lowell Lectures	3,500.00	
Land and Building, Clarendon St., on account	6,500.00	
Use of Rooms and Gymnasium	609.14	
Cambridge Real Estate	148.54	$10,757.68

Department Supplies and Repairs.

Applied Mechanics	1,891.77	
Architecture	4,558.30	
Biology	1,317.90	
Brookline Athletic Field	600.00	
Chemistry	14,089.36	
Civil Engineering	3,342.12	
Drawing	1,130.35	
Economics	419.46	
Electrical Engineering	6,897.21	
English	215.56	
General Library	2,233.85	
Geology	1,855.46	
Heat Measurement	1,444.60	
History	653.80	
Mathematics	257.35	
Mechanic Arts	2,279.61	
Mechanical Engineering	3,234.20	
Military	508.46	
Mining	3,643.21	
Modern Languages	244.37	
Naval Architecture	785.63	
Physical Culture	122.16	
Physics	7,128.96	$58,853.69

Salaries.

Instruction	286,039.37	
Administration	39,196.79	
Labor	43,268.39	$368,504.55

Repairs to Buildings.

Rogers Building	2,699.36	
Walker "	934.37	
Engineering Buildings, A and B	805.33	
Pierce Building	364.57	
Engineering Building, C	180.23	
Lowell Building	1,399.01	
Gymnasium Building	28.47	
Mechanical Laboratories	9,030.42	
Boiler and Power House	1,154.44	
Sundries	247.71	$16,843.91

General Expense.

Window Shades		98.35	
Furniture		436.02	
Stationery and Office Supplies		2,284.39	
Postage		727.62	
Sundries		1,666.24	
Express		259.41	
Janitor's Supplies		1,409.34	
Examinations		520.00	
Diplomas and Commissions		957.40	
Washing		827.49	
Telephone Service, Installing Stations, Rentals, Repairs, etc.		1,105.94	
Engine Room Supplies:			
Oil	408.20		
Waste	226.19		
Sundries	107.53	741.92	
Ice		394.15	
Graduation Exercises		146.48	
Removing Ashes		295.50	
Glass		25.35	
N. E. Trust Co. Deposit Vaults		75.00	
State St. Trust Co. Deposit Vaults		75.00	
Union Safe Deposit Vaults		25.00	
Legal Services		242.80	
Taxes, Brookline		1,948.59	$14,261.99

EXPLANATION OF CHARTS.

Cost of Water.

In January, 1905, the condensing water discharged from all the condensers was turned into the cooling tower. Previous to this time the cooling tower had been used for the power plant only, and the other condensers were supplied with hydrant water which went to waste after leaving the condensers. The same water is now cooled and used over and over again.

The saving in the cost of water is quite apparent, beginning in February, 1905.

The saving from this source is even greater than the curve shows, for the amount of water required by the boilers has increased steadily.

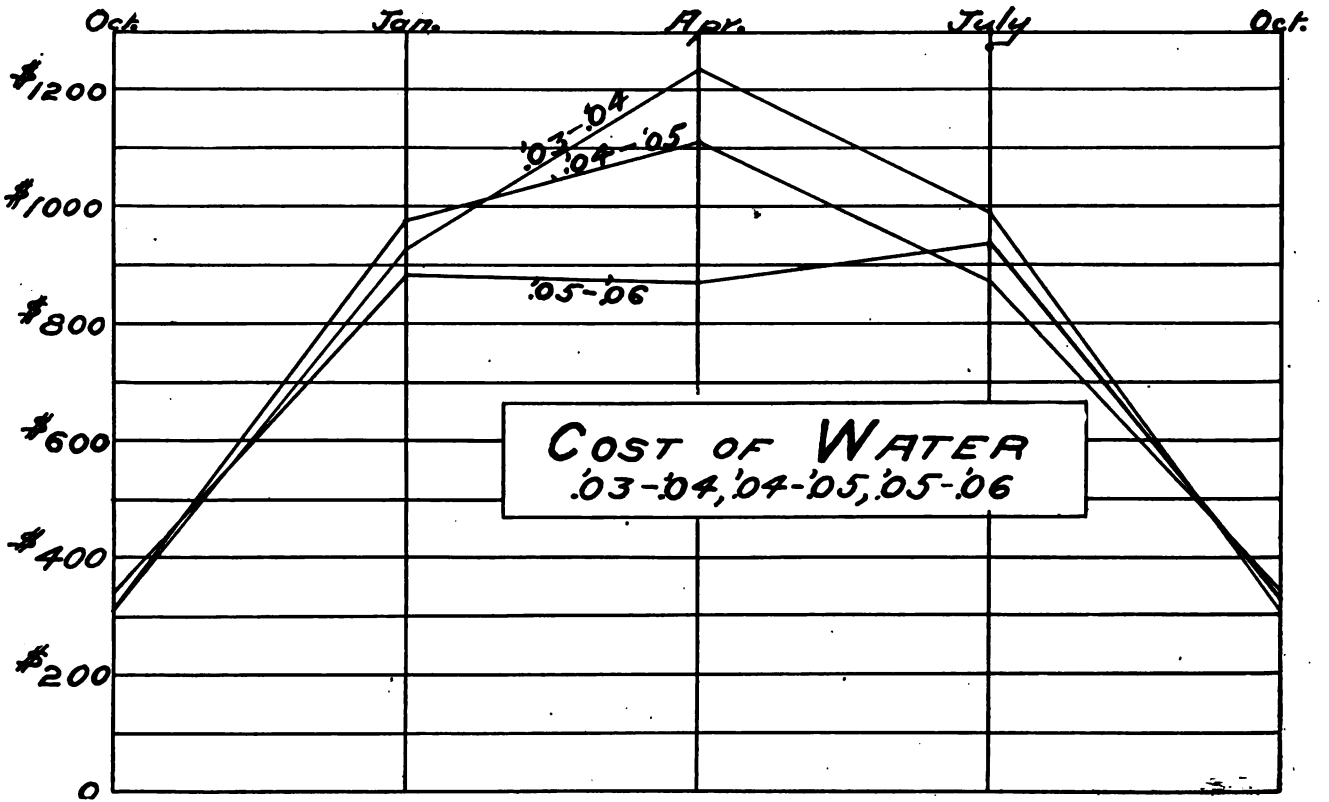
Cost of Coal.

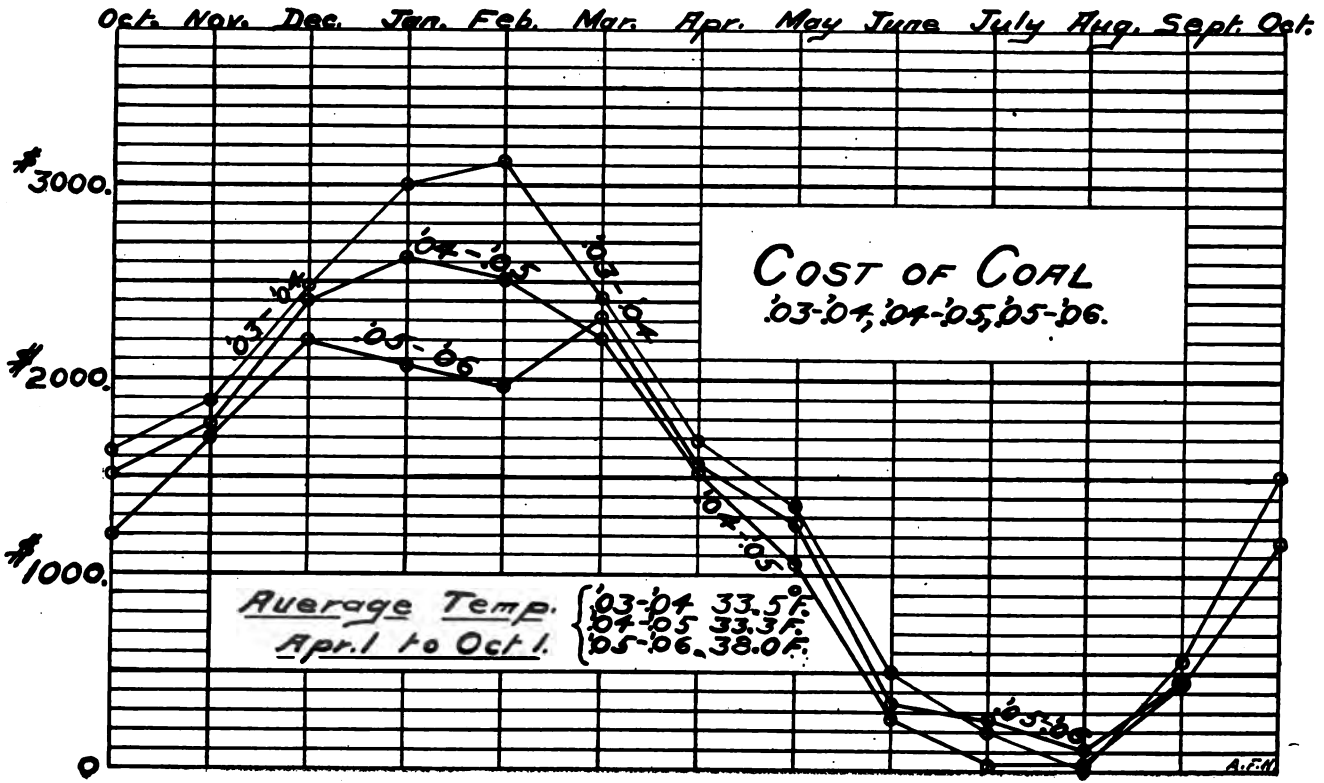
The cost of coal for 1905–06 shows a marked saving. The saving beyond February is not apparent from the cost curve alone, but becomes evident when the curve giving the kilowatt output of the plant is considered.

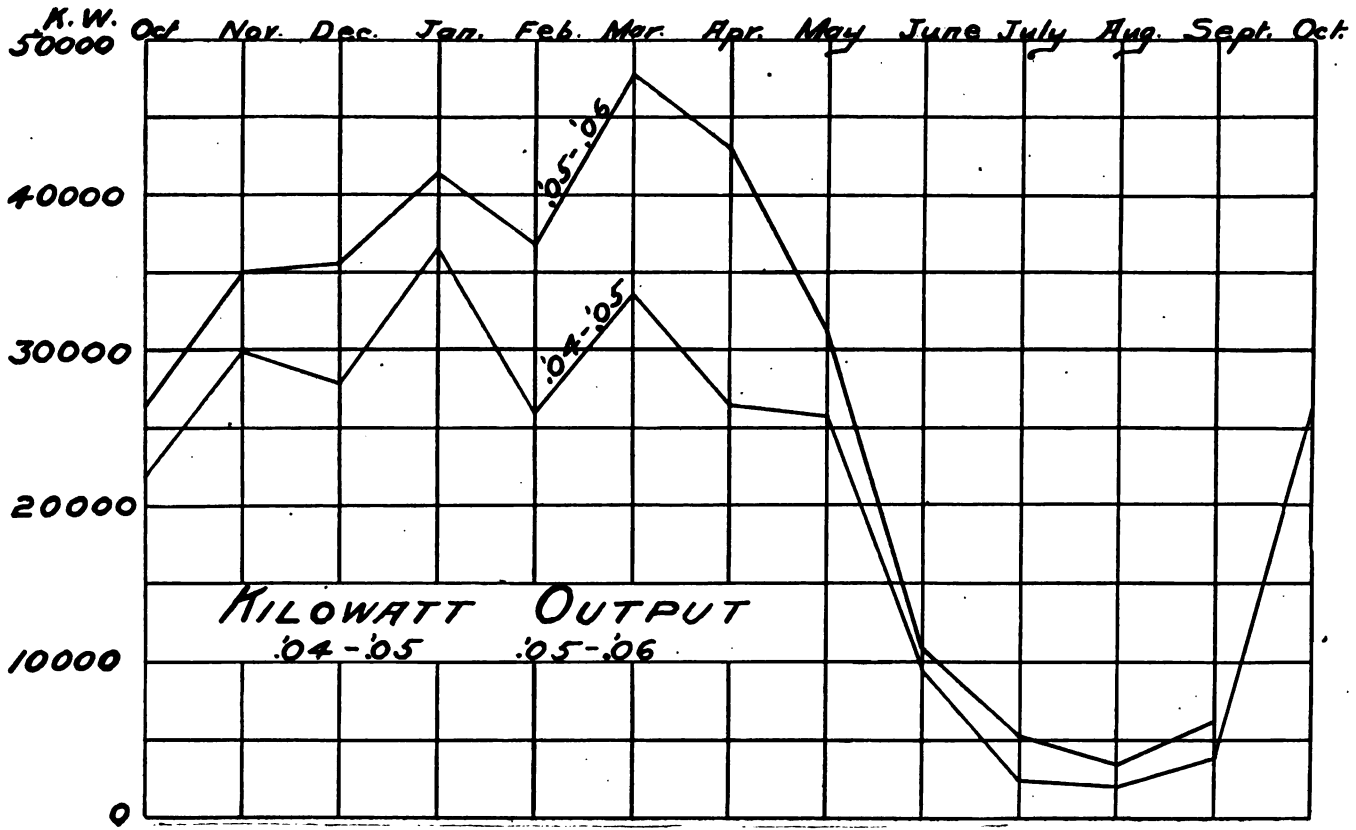
The average output is about 10,000 K.W. greater for February, and 15,000 K.W. greater for March and for April than in the year previous, in spite of which the cost of coal for this period is about the same as in the previous year.

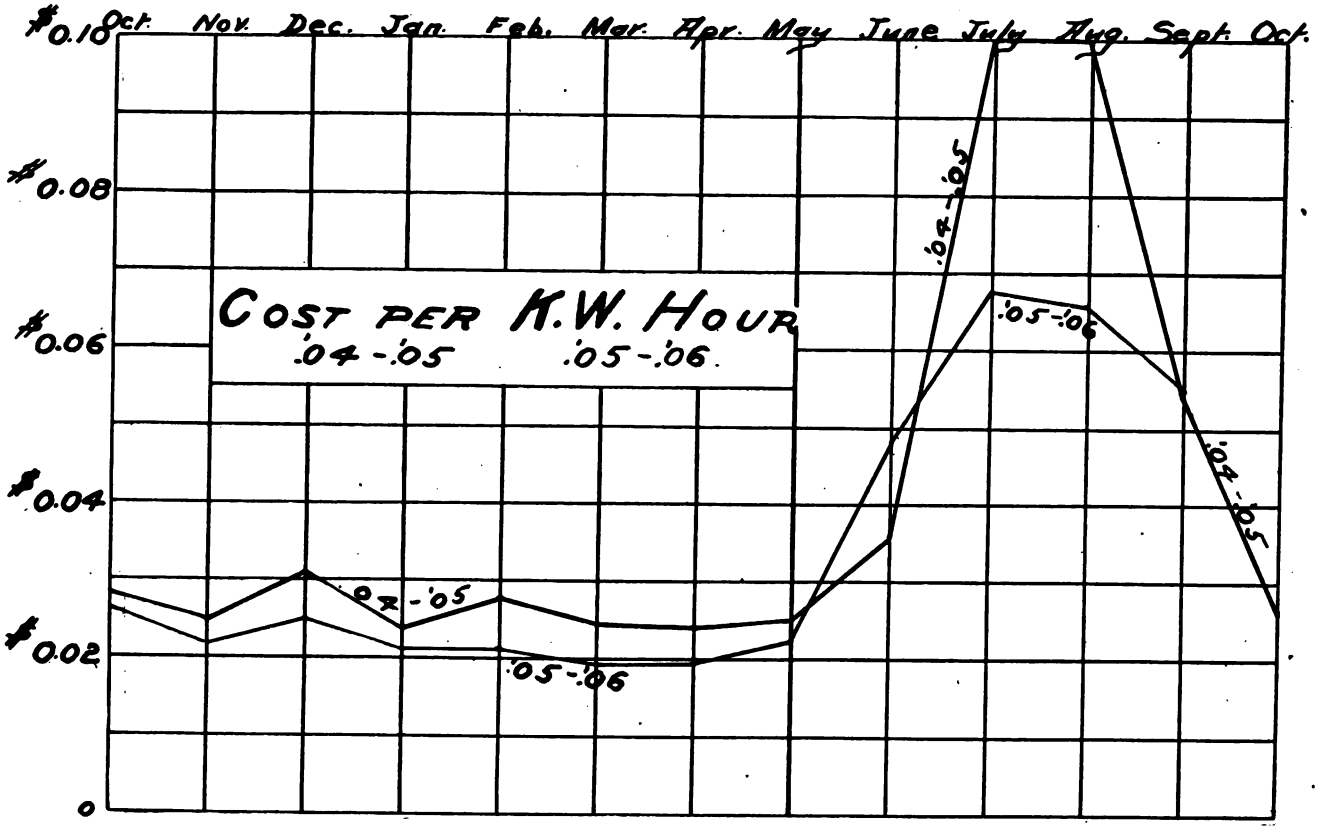
Cost per K.W. Hours.

The cost per K.W. hour is figured on the basis of four pounds of coal per K.W. hour, this figure having been obtained from tests of a week's duration, and of thirty pounds of water per K.W. hour. It includes both the cost of labor of all firemen, coal-passers and engineers of the power plant, and also that of waste, oil and all ordinary repairs.


Oct.
Jan.
Apr.
July
Oct.
$1200
$1000
$800
$600
$400
$200
0
'03-'04
'04-'05
'05-'06
COST OF WATER
'03-'04, '04-'05, '05-'06


Oct. Nov. Dec. Jan. Feb. Mar. Apr. May June July Aug. Sept. Oct.
#3000.
#2000.
#1000.
0
COST OF COAL
'03-'04, '04-'05, '05-'06.
'03-'04
'04-'05
'05-'06
Average Temp.
Apr. 1 to Oct. 1.
'03-'04 33.5°F.
'04-'05 33.3°F.
'05-'06 38.0°F.
A.F.M.


K.W.
Oct
Nov.
Dec.
Jan.
Feb.
Mar.
Apr.
May
June
July
Aug.
Sept.
Oct.
50000
40000
30000
20000
10000
0
'05-'06
'04-'05
KILOWATT OUTPUT
'04-'05
'05-'06


$0.18
$0.08
$0.06
$0.04
$0.02
0
Oct. Nov. Dec. Jan. Feb. Mar. Apr. May June July Aug. Sept. Oct.
COST PER K.W. HOUR
.04-.05 .05-.06.
.04-.05
.05-.06
.04-.05
.05-.06
.04-.05

BOSTON, Nov. 26, 1906.

Mr. Edward L. Parker, a public accountant, employed by this committee, has examined the accounts of the Treasurer of the MASSACHUSETTS INSTITUTE OF TECHNOLOGY for the year ended September 29, 1906, and has verified the Students' Notes and the cash at office and in banks, and his report is hereto annexed.

We have verified the list of securities held by the Institute.

CHARLES C. JACKSON, } *Members of the*
JAMES P. TOLMAN, } *Auditing Committee.*

BOSTON, Nov. 26, 1906

To the Auditing Committee of the
Massachusetts Institute of Technology:

GENTLEMEN,—I have audited the accounts of Mr. George Wigglesworth, Treasurer, for the year ended September 29, 1906.

They are correct, payments duly vouched, and the receipts from students' fees and all other income duly accounted for. The cash at office and in banks, according to the deposit books, is correct, and the Students' Notes are on hand. The account of property held by the Institute and the funds, and balances, as shown in the Treasurer's report of September 29, 1906, is in accordance with the books.

Respectfully submitted,

EDWARD L. PARKER,
Public Accountant.

Volume 43 Number 2

BULLETIN

OF THE

Massachusetts Institute of Technology

BOSTON

REPORT

OF THE

PRESIDENT AND TREASURER

PRESENTED AT THE DECEMBER MEETING OF THE CORPORATION

JANUARY, 1908

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REPORT OF THE TREASURER.

Members of the Corporation.

Acting President.

ARTHUR A. NOYES.

Secretary.

JAMES P. MUNROE.

Treasurer.

FRANCIS R. HART.

Life Members.

WILLIAM ENDICOTT.
HOWARD A. CARSON.
CHARLES J. PAINE.
CHARLES FAIRCHILD.
DAVID R. WHITNEY.
FRANCIS H. WILLIAMS.
JAMES P. TOLMAN.
HOWARD STOCKTON.
NATHANIEL THAYER.
CHARLES F. CHOATE.
HIRAM F. MILLS.
PERCIVAL LOWELL.
CHARLES C. JACKSON.
SAMUEL M. FELTON.
DESMOND FITZGERALD.
FRANCIS BLAKE.
CHARLES W. HUBBARD.
THOMAS L. LIVERMORE.
A. LAWRENCE ROTCH.
GEORGE WIGGLESWORTH.
JOHN R. FREEMAN.
WILLIAM H. LINCOLN.
J. B. SEWALL.
CHARLES L. LOVERING.
A. LAWRENCE LOWELL.
WILLIAM L. PUTNAM.
EBEN S. DRAPER.
ROBERT S. PEABODY.
ELIHU THOMSON.
ELLIOT C. LEE.
JAMES P. STEARNS.
LUCIUS TUTTLE.
FREDERICK P. FISH.
FRANCIS L. HIGGINSON.
CHARLES A. STONE.
W. MURRAY CRANE.

Term Members.

Term expires March, 1909.

FREDERICK H. NEWELL.
RICHARD H. SOULE.
EBEN S. STEVENS.

Term expires March, 1910.

FREDERICK K. COPELAND.
JOSEPH P. GRAY.
FRANK L. LOCKE.

Term expires March, 1911.

THOMAS C. DU PONT.
CHARLES T. MAIN.
FREDERICK W. WOOD.

Term expires March, 1912.

GEORGE W. KITTREDGE.
FRANK G. STANTIAL.
GEORGE E. HALE.

On the Part of the Commonwealth.

HIS EXCELLENCY, CURTIS GUILD, JR., *Governor.*
HON. MARCUS P. KNOWLTON, *Chief Justice of the Supreme Court.*
HON. GEORGE H. MARTIN, *Secretary of the Board of Education.*

Committees of the Corporation.

Executive Committee.

ARTHUR A. NOYES. } *Ex Officio.*
FRANCIS R. HART. }

FRANCIS H. WILLIAMS. CHARLES A. STONE.
THOMAS L. LIVERMORE. FREDERICK P. FISH.
FREDERICK W. WOOD.

Finance Committee.

WILLIAM ENDICOTT. NATHANIEL THAYER.
DAVID R. WHITNEY. CHARLES F. CHOATE.
CHARLES C. JACKSON. JAMES P. STEARNS.

Committee on the Society of Arts.

HOWARD A. CARSON. HIRAM F. MILLS.
ROBERT S. PEABODY.

Auditing Committee.

CHARLES C. JACKSON. JAMES P. TOLMAN.
WILLIAM L. PUTNAM.

Committee on Nominations.

DAVID R. WHITNEY. JAMES P. MUNROE.
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Report of the Acting President.

To the Members of the Corporation:

I have the honor to present to you to-day a report upon the progress of the Institute during the preceding year, and upon the larger problems of development with which it is now confronted. In speaking of this matter of development, one occupying only temporarily the office of the presidency naturally feels much hesitation; but I have believed that it would be of interest to you to hear the views of one who has for many years been a member of your Faculty; and I shall, therefore, venture to express myself freely upon our future policies. Let me, however, first recount to you briefly the history of the past year.

CHANGES IN THE CORPORATION AND FACULTY.

The Corporation has during that period suffered the loss of one of its oldest members, Mr. Alexander S. Wheeler, whose services to the Institute give him a pre-eminent place among the many friends to whom it owes its foundation and development. He was a member of this Corporation from 1882 until the time of his death, and a member of the Executive Committee from the date of its formation until the year 1902. A memorial of his services and of our appreciation and gratitude for his devotion is to be presented to you to-day by one of your members who was closely associated with him.

The Corporation has welcomed to its membership three new term members, elected from the nominees of the Alumni Association,—Dr. George E. Hale, of Pasadena, California; Mr.

George W. Kittredge, of New York City; and Mr. Frank G. Stantial, of Everett, Massachusetts.

There have been several changes in your administrative officers. Upon the first of last July, Dr. Henry S. Pritchett, after a service of seven years, retired from the presidency to devote himself to the work of the Carnegie Foundation for the Advancement of Teaching; and I was requested to perform the duties of the office till such time as a permanent president shall be appointed. Mr. George Wigglesworth, upon the first of October, resigned from the position of treasurer, which he has occupied since 1891. The eminent service which he has so freely and generously rendered to the Institute during this long period has been recognized, so far as words can do so, by the resolutions adopted at your last meeting; but every friend of this school has a deep-seated feeling of gratitude which cannot be given adequate expression. The Institute is to be congratulated in having secured as its new treasurer Mr. Francis R. Hart, who brings to the work enthusiasm, devotion to the interests of the Institute, and a wide financial experience. He becomes *ex officio* a member of your body and of your Executive Committee. At the annual meeting in October Mr. James P. Munroe was elected Secretary of the Corporation for the ensuing year.

During the past year five members of the Faculty have withdrawn: Professor William O. Crosby, retiring under the Carnegie Foundation to devote himself exclusively to his geological investigations; Professor George V. Wendell, to take charge of the Department of Physics at the Stevens Institute of Technology; Professor Frank P. McKibben, to take charge of the Department of Civil Engineering at Lehigh University; Professor Richard W. Lodge, to devote himself to private practice; and Professor Douglas W. Johnson, to give all his time to his work at Harvard University as Assistant Professor of Physiography.

Within the Faculty advancements have been made from the grade of Associate Professor to that of Professor as follows: John O. Sumner, Professor of History; Frederick H. Bailey,

Professor of Mathematics; Henry Fay, Professor of Analytical Chemistry.

The following men, formerly Assistant Professors, have been promoted to Associate Professorships: Henry G. Pearson, Associate Professor of English; Ralph R. Lawrence, Associate Professor of Electrical Engineering; Harrison W. Smith, Associate Professor of Electrical Engineering; George C. Shaad, Associate Professor of Electrical Engineering.

Thirteen new members have been added to the Faculty, of whom the four following have come to us from outside positions: Reginald A. Daly, Professor of Physical Geology, formerly of the Geological Survey of Canada; Edwin B. Wilson, Associate Professor of Mathematics, formerly of Yale University; Lewis E. Moore, Assistant Professor of Civil Engineering, formerly of the University of Illinois; Edward E. Bugbee, Assistant Professor of Mining Engineering and Metallurgy, formerly of the University of the State of Washington.

The remainder were previously instructors at the Institute. They are as follows: Leonard M. Passano, Assistant Professor of Mathematics; George L. Hosmer, Assistant Professor of Civil Engineering; Charles B. Breed, Assistant Professor of Civil Engineering; Maurice DeK. Thompson, Assistant Professor of Electro-Chemistry; Henry L. Seaver, Assistant Professor of English; Miles S. Sherrill, Assistant Professor of Theoretical Chemistry; George E. Russell, Assistant Professor of Civil Engineering; Gilbert N. Lewis, Assistant Professor of Physico-Chemical Research; Earle B. Phelps, Assistant Professor of Research in Chemical Biology.

FACULTY ORGANIZATION.

The Faculty has during the past year perfected its organization and has made provision for carrying on more effectively its administrative functions by the creation of the office of Chairman and by the appointment of new committees on Faculty Business, on Faculty Rules, and on the Courses of Instruction.

In the report of the Secretary of the Faculty will be found not only a fuller presentation of these matters, but also certain resolutions of the Faculty in which its opinions are expressed as to the character of Faculty organization and the methods of administration best adapted to the conditions of the Institute. Our Faculty, like that of many other educational institutions, has now become so large that it cannot properly deal with the details of administration; but instead of establishing a single administrative board consisting of a small number of its representatives, it has gradually developed the more democratic, and, it believes, the more effective, plan of placing its numerous and varied functions under the charge of about twenty-five standing committees, which are empowered to take final action upon all special and individual cases that arise, and are expected to take the initiative in submitting to the Faculty for its approval any important changes of policy or procedure that seem desirable. I would especially call your attention to the resolution in which the Faculty, in response to the suggestion of President Pritchett, "expresses its appreciation of the desirability of some form of advisory relation between the Corporation and the Faculty, and its readiness to co-operate with the Corporation in the preparation of a plan for establishing such a relation."

REGISTRATION STATISTICS.

The membership of the Faculty has been increased from 78 to 86, and the number of instructors and assistants from 121 to 124. There are, in addition, 11 research associates and assistants devoting themselves almost wholly to investigation work.

The total registration of students is now 1410, while that at the same time last year was 1397. The proportion of Massachusetts students (55½ per cent.) is nearly the same as in recent years. The number of foreign students has increased from 47 in 1902 to 80 this year, or from 3.0 to 5.7 per cent. of the whole. The proportion of new students who have previously

attended other colleges has increased from 19 per cent. five years ago to 29 per cent. the present year. There is no very marked change in the distribution between the several Courses. The three largest Courses are as in the past those in Mechanical, Civil, and Electrical Engineering, with 226, 210, and 200 students, respectively. Next comes the Course in Mining Engineering and Metallurgy with 118 students, showing this year an increase of 18 students, the largest in any Course. The average age of students entering the first year is 18 years 11 months, one month greater than last year.

Other interesting statistical information will be found in the report of the Registrar.

DEVELOPMENTS IN THE WORK OF INSTRUCTION.

The further history of the past year will be found recorded in some detail in the reports of the general administrative officers and of those in charge of departments, which are submitted herewith. To these I invite your special attention. I can speak here only of the more important developments, especially of those relating to the work of instruction.

The curricula of all the strictly engineering courses have been modified during the past two years by the omission, wholly or in part, of the second-year work in modern languages; and the time gained has been utilized to increase the amount of instruction in English and history, and to give a more thorough drill in fundamental engineering subjects, especially in applied mechanics, structures, and steam engineering. It is felt that few engineers make practical use of their knowledge of modern languages, and that the general and scientific studies that have been substituted are not only more directly useful, but either have a higher cultural value or provide a better mental training.

Important progress in the development of our advanced work has been made by greatly extending and systematizing the subjects of instruction offered to candidates in fifth-year courses leading to the degree of Master of Science. Almost

every department has announced, and is prepared to offer in the next school year, advanced courses of a somewhat more specialized character than can be given to undergraduate students. Thus, in civil engineering further work in the design of structures (particularly those of re-enforced concrete), of railroads, and of hydraulic works, is offered; in mechanical engineering, further study of turbine and gas engines and of machine design is provided for; in architecture, advanced courses in the various branches of architectural design are announced; and similarly in all other departments advanced work has been arranged for. The broad significance of this form of development and its bearing on the character of our undergraduate courses I shall speak of later.

A special inducement to pursue such advanced work has been offered to graduates from other colleges by a recent vote of the Faculty, which permits them to enter at once upon a course leading to the degree of Master of Science without previously taking our Bachelor's degree. This course will, in general, extend over a period of two or three years, varying according to the previous preparation of the college student.

There are, however, no developments of any kind which are so important as those which tend to increase the effectiveness of our undergraduate instruction in meeting the needs of the individual student. I am glad to be able to tell you that this year an important step in this direction has been taken by the initiation of a plan of individual conferences between the instructor and students in certain first-year subjects. Owing to the inadequacy of the funds available for the purpose—for it involves additional instructors of first-rate ability—it has been possible this year to put this plan in force only to a limited extent in the subjects of English and mathematics. It is, I believe, of great importance that this plan be largely extended as rapidly as our facilities admit; for it is undoubtedly true that many of the students who now fail to reach our standards, could overcome their difficulties if they could receive more help in learning how to study and more personal encouragement

and stimulation. The conference plan also develops an attitude of cordiality and mutual helpfulness in both the instructing staff and the student body which is the essence of a healthy college spirit.

The instruction in the Department of Mathematics is undergoing a somewhat radical revision, in which the old divisions into advanced algebra, analytic geometry, differential and integral calculus are in large measure obliterated, and the whole subject is presented, irrespective of this traditional grouping, in a manner most economical and advantageous for the student, and with the help of a large number of concrete applications.

The Department of English is trying the interesting and apparently successful experiment of dividing its students into sections upon the basis of their proficiency. This division makes it possible to give instruction better adapted to individual needs: on the one hand it avoids holding back the brighter students, and on the other it makes it possible to help more effectively those who need it most. A trial of this plan in other subjects of instruction seems advisable.

THE NEEDS OF THE DEPARTMENTS.

The immediate needs of the various departments should not pass unnoticed here, even though they are more fully presented in the separate reports of those in charge.

Nearly all of the departments are in serious need of additional floor-space for laboratories, class-rooms, and places for students to study. The demand for better laboratory accommodations is perhaps most urgent in the Departments of Mechanical Engineering, Mining Engineering, and Chemistry. In the first of these departments some additional provision must be made at once in order that the recently purchased steam turbine and its accessories may be installed; and in the Chemical Department the much larger number of students who will take organic chemistry next year, owing to changes in the course schedules, cannot be accommodated with the present facilities.

Additional equipment is also much needed by several departments. Some of the larger and most essential machines are as follows: a surface condenser, refrigerating plant, impact tester, and a locomotive testing plant are important to the Department of Mechanical Engineering, additions the need of which has been strongly urged by your visiting committee for that Department; new engine and speed lathes and other machines, as well as extensive repairs to the building, are required by the Laboratories of Mechanic Arts; a large storage battery is greatly needed by the Electrical Engineering Department; and a new boiler for the heating and power plant is essential before the beginning of the next school year.

Provision for a Travelling Fellowship is considered especially important by the Department of Architecture in order that the opportunity for foreign study may be open to its most capable graduates.

THE EDUCATIONAL FIELD OF THE INSTITUTE.

It is well, I believe, for the Corporation to take under consideration from time to time those fundamental principles which express the main purposes for which the Institute exists and which should determine the educational field which it is to occupy and the directions in which it is to be developed. In this belief, I present my views for your consideration.

Its Function as an Undergraduate School.

First of all, I believe that it should be clearly recognized that one of its main functions, as an independent scientific school, is to educate for the scientific and engineering professions young men who have previously received only a high-school education. It must remain in large measure a school for undergraduates, and must not allow itself through the influence of the policies of universities to become only a graduate school for the professional training of the former students of other colleges. The question here at issue is not which is more

advantageous—a professional training preceded by a liberal education of an elective character or a co-ordination of the two in a single prescribed course,—but whether or not there is a large field for education of the latter type. Some may prefer to drive tandem, with a loose rein upon the leader, and some to drive abreast; but none wishes his freedom of choice restricted. By the establishment in this community of the Graduate School of Applied Science at Harvard University, and by a similar development at other universities throughout the country, ample provision will doubtless be made, as fast as the demand arises, for the engineering education of college graduates. It should be, on the other hand, the especial care of the Institute to maintain and develop that combination of liberal and professional training for undergraduate students for which it has stood from its foundation. If ever the demand for this type of education should cease, or if ever it be demonstrated that this type when best developed produces only engineers and scientists of an inferior grade, then, and not till then, will it be time to consider the conversion of the Institute into a purely graduate school. To abandon at this stage the educational experiment which the Institute is making, instead of coping with the difficulties in its problem which have become apparent, would be a betrayal of the trust which its past imposes and a severe blow to the educational development of this country. There is as yet no indication that the sources that have directly fed the streams which are inundating our technological schools are drying up, nor is there as yet any adequate experience which warrants us in diverting those streams into a different channel. It is certainly desirable that there be developed the new type of engineering education, in which cultural subjects are given as collegiate courses and the professional training is given in a graduate school. Such a development, indeed, is to be welcomed as a stimulus to us to study the conditions for making our own type of education more effective. We must, however, realize that this is not *our* field of educational service, and we must not allow our attack upon the problems of undergraduate

education to be weakened by theories as to the tendencies of professional education under university conditions.

The second principle which I desire to emphasize is that already indicated by my preceding words, namely, that, as an independent undergraduate school, the educational problem of the Institute is necessarily of a twofold character: we have to develop a plan of education which is adapted to produce not only well trained engineers, but also broad-minded, high-purposed men. We must aim to make the work of the students at the Institute and the conditions of their life outside such as lead to a duly proportioned development in these two directions.

It is sometimes said, however, that in attempting to solve this twofold problem in a four-year undergraduate course, the Institute is undertaking a hopeless task. This contention I would meet by the statement, that, whether or not it be hopeless to give a fully adequate education upon these two sides within the period of four years, it is our present problem to do this in as large a measure as is possible; for to increase further this minimum period of study would close the doors of the institutions of technological education to a large number of young men whose financial resources are already taxed to the utmost. Moreover, the careers of Institute graduates warrant the conclusion that the results attained in the past are as a whole satisfactory; and when the many possibilities of further development in our educational work and the conditions of student life are considered, the future outlook for a fuller success of the four-year course is a bright one. Before conceding the necessity of an extension of this period of study, we must at least consider the possibility of utilizing in part the intermediate summer vacations, which now cover no less than one-third of the whole year; to this matter I shall return when I consider the specific lines of development which are most imperative.

Advanced Courses for Specialization.

The general principle which should determine the character of our four-year course of study—a principle fully recognized

by our Faculty—is that a liberal education be provided such as will develop character, breadth of view, and high ideals of service, and that the professional education be mainly confined to a thorough training in the principles of the fundamental sciences and in scientific method, specific engineering subjects being included only so far as the remaining time permits and as the minimum requirements of professional practice demand. It should be our aim not to turn out a specialist at the end of a four-year curriculum, but rather to provide for specialization in a fifth-year graduate course. By courageously eliminating from our fourth-year curriculum the more technical branches in instruction, however important they may be for the practising engineer, and by making more ample provision for them as subjects to be pursued in graduate courses, we shall, on the one hand, be enabled to make our undergraduate course more educational in the broadest sense, and, on the other hand, to make more evident to the student the practical importance of returning for a fifth year to acquire the more specialized knowledge of the separate engineering professions. This, then, is the direction in which, in my judgment, the courses of study at the Institute should be developed: we will give in our four-year undergraduate course an even broader and deeper training than at present in cultural and fundamental scientific studies;—a training which will still enable those students that are obliged to do so to enter at once upon the practice of their professions, handicapped somewhat, it may be, by the lack of technical experience, but with a sound knowledge of principles and a developed mental power which will gradually enable them to overcome this disadvantage; and, on the other hand, we will develop graduate courses of such a character as will obviously remedy this deficiency of insufficient specialization and will attract such graduates of this institution and of other scientific schools as are financially able to continue their education. We shall thus create a type of graduate school in which is offered advanced training for Bachelors of Science rather than for Bachelors of Arts.

Opportunities for College Graduates.

But these are by no means the only fields which the Institute should occupy. Some of the other directions in which our development should be continued or extended also deserve consideration.

We must, while not permitting any sacrifice of the instruction of our undergraduate students, encourage the graduates of colleges to enter the higher years of our regular courses and our advanced courses, and offer them such additional facilities as their different preparation demands. Future experience alone can determine whether such graduates will receive a better education in the graduate schools of universities in courses attended often not only by themselves, but by college men without definite professional aim, or in scientific schools working side by side in the undergraduate courses with men earnestly devoted to preparation for their profession. The presence together of these two groups of men is certainly mutually advantageous: the graduate student from another institution tends to broaden the interests of his undergraduate associate; and the latter imbues the former with that spirit of hard work and seriousness of purpose which attendance at the scientific school has inspired. For these reasons we must not fail to provide suitable courses and conditions of work for the college graduates who are coming to us in constantly increasing numbers.

Five-year Courses for the Bachelor's Degree.

More important, however, than the offering of increased opportunities for college students is a more ample provision within this institution itself for the education of such students coming directly from the preparatory schools as are able to devote more than four years to general and fundamental studies. In emphasizing the importance of maintaining our undergraduate four-year course, I should be sorry to give the impression that that period is considered a fully adequate one. On the

contrary, I believe the Institute should at once meet the demand for a broader education of its students by a development of a three-year Course in General Science, which shall contain, partly as required work and partly as electives, all or nearly all those subjects of instruction now included in the first two years of the various Courses of the Institute, so that the latter may be completed in two years more by students who have finished the three-year science course. This plan would enable three years instead of two to be devoted to the humanistic branches of study, to the nature sciences, and to the fundamental physical sciences. It would in large measure provide the breadth of scholarship which the college course is designed to supply, and would do this by the methods and in the atmosphere of the scientific school. Owing to the facts that a long list of electives in general studies is already offered to our third-year students, and that many of the scientific subjects that would naturally be included are already given by one or other of our science departments, this course in general science could be arranged for at comparatively small additional expense. It would be desirable, however, that one new professor be appointed, who might offer courses in philosophy, psychology, and logic.

Another similar opportunity for a broader education and a more thorough training can be provided through the announcement of more definite five-year schedules in each of the larger engineering branches. Such five-year courses would also make provision for those conscientious, thoughtful students who have the mental ability to do our work satisfactorily, but cannot do so at the rate and under the pressure which our four-year curriculum involves. These matters are under consideration by the Faculty.

Courses for Research and Advanced Study.

Development is also of the greatest importance in the direction of larger opportunities and inducements for research work and advanced studies in the pure and applied sciences which

form the basis of our curriculum. An institution of learning which does not contribute through the researches of its instructing staff and graduate students to the advancement of science cannot secure the highest grade of teachers, cannot keep its courses of instruction upon the plane of broad and deep scholarship, and cannot retain its educational prestige. I have already spoken of one kind of advanced course which we are already developing,—one which would provide the more specialized instrucion in engineering subjects which industrial advances are making more and more imperative. Such a course, which hardly needs to be of more than one year's duration, leads to the degree of Master of Science. There is, however, a second kind of advanced course which is even more essential to the development of the highest type of scientist or engineer. This is a course in which the student, while pursuing more advanced studies in the underlying sciences, devotes himself mainly to the original investigation of problems in pure or applied science. It is investigation work of this sort which tends to develop the creative power of the man and his ability to handle new problems relating to the improvement of industrial processes and engineering methods. Such a course, when of two or three years' duration, may lead to the degree of Doctor of Philosophy or Doctor of Engineering. The Institute has already made encouraging progress in this direction; but the number of students engaged in such work has thus far been small. This matter of research work, both with reference to advanced students and the members of our own instructing staff, I shall consider more fully a little later.

THE PROBLEMS OF DEVELOPMENT.

Let me next speak of what may be called the larger problems of development—of those lines of action which are essential to the fuller accomplishment of our educational purposes as I have set them forth.

It is scarcely necessary to mention that one of the most

important of these problems is the selection of a permanent president who has a true conception of the educational ideals of the Institute, combined with the high character, soundness of judgment, and power of initiative and of energetic execution that will make him an effective agent in the realization of those ideals. The qualifications for the office are so numerous and varied that their combination in a single person is extremely rare; and all such persons are in great demand for the highest executive positions. With the consideration of this matter the Executive Committee is still actively engaged.

Another matter of the greatest moment is the reaching of a decision as to the permanent location of the Institute, in order that its future development may be assured and its immediate needs adequately provided for. I shall not, however, discuss this question, for I know that you fully realize its vital significance. You have appointed a Committee of your body to deal with it; and that Committee will doubtless take action, and report to you as promptly as possible. It will of course be appreciated that the first preliminary to any action must be a careful consideration of the means for financing the undertaking, and that the present monetary situation makes this impracticable. Friends of the Institute should, however, realize that again in its history the time has arrived when provision must be made for far-reaching improvements in the physical conditions under which its work is carried on. New buildings must be erected, new laboratories provided, and new equipment secured, in order that the Institute may retain its leadership in technological education. And these are not matters that can be much longer deferred.

Reduced Tuition Fees and Increased Scholarship Funds.

Next in importance to this matter of making provision for our immediate needs and future development comes the question of reduced tuition fees or increased scholarship aid. The inadequacy of our endowment, combined with the high cost of the kind of instruction furnished by the Institute, made it seem nec-

essary a few years ago to increase our tuition fee to $250. This increase will, I earnestly hope, be regarded as only a temporary expedient for which a remedy must be found at the earliest moment. The present high tuition not only is shutting out a large group of promising young men from the advantages of a scientific and engineering education, but is imposing upon another large group a financial burden which they are scarcely able to bear, and which forces them to live and to work under conditions unfavorable to their health and social development. Any of the administrative officers of the Institute could recount numerous instances where men have been obliged to withdraw from the Institute because they could not raise the last fifty dollars of their tuition, or where they have been living on thirty or forty cents a day in order to meet it. Our high tuition is, moreover, sending young men more and more to the other less expensive collegiate institutions. Many of these take the full courses of study there, but there is a large and increasing number who for reasons of economy replace the first year or first two years of the Institute course by corresponding work at another institution, and then enter the second or the third year of the Institute. There is involved in this plan a lack of continuity and of adequate preparation which is unfortunate.

While we are not interested in bringing about any large increase in the number of our students, we are concerned in drawing to us young men of the highest quality. We must, therefore, not permit the financial resources of applicants to be the principle of elimination in any greater measure than is absolutely essential. There is, in my opinion, no form of educational expenditure which produces so large a return to the community as the higher training for the scientific and engineering professions of those comparatively few young men whose character and ability are such as to enable them to rise to positions of leadership. And this type is, I believe, most commonly developed among families which have sufficient means to send their sons to the high school, but yet have trained them to work in the summers and at other odd times to earn

money towards their own support. Boys from poorer families are unfortunately not likely to have the opportunity of even a high-school education, or the home surroundings or antecedents which conduce to intellectual development, while those from richer families are apt to lack the earnestness of purpose and the inclination to subordinate the pursuit of pleasures to thorough preparation for a life of service which is acquired by the boy who has already learned to work. It is, however, just such families of small means which are finding it exceedingly difficult, if not impossible, to meet the high expense of technological education.

This difficulty may be met in one of two ways,—by a general reduction of our tuition fee or by providing larger funds for scholarship aid to individual students. Under the existing conditions a combination of the two methods seems most advisable. To reduce our tuition fee for all our students would involve such a large reduction of our income that it probably cannot be immediately considered; but it might be practicable to adopt the plan of reducing the tuition fee for first-year students. Assuming a first-year class of three hundred and thirty students, a reduction in the fee of only $50 would involve a decrease of $16,500 in our annual income; but this might be partly offset by the increase which it would probably cause in the number of first-year students. The advantages of this reduction in tuition for first-year students are proportionally far greater than a corresponding reduction for those of the higher years—desirable as the latter is. It would enable a larger number of properly prepared students to enter the Institute; and the most deserving of these, after they had demonstrated their ability by their first year's work, could be assisted to continue by grants from our scholarship funds and those of the State, which can not be awarded with proper discrimination to boys in advance of their coming to the Institute. Moreover, as the student gets older and has had more training, it is easier for him to get remunerative employment in the summer vacations. It will, too, diminish the tendency for students to go to other institu-

tions for a single year or two merely for reasons of economy. Finally, it is the most equitable and from a financial standpoint the safest course for the Institute to pursue in effecting a reduction of its tuition charges, since the first-year instruction is less costly than the more specialized instruction of the higher years.

This plan would, however, remedy only in part the difficulties of our high tuition; for our scholarship funds are not adequate to meet the needs of our deserving students in the higher years. This is fairly evident merely from the statement that the scholarship grants to undergraduate students formed last year only nine per cent. of the total tuition fees paid by them. Ampler funds must therefore be secured either through an appeal to the generosity of private donors or through further grants from this Commonwealth, which cannot afford to allow the opportunity of a higher technological education to remain closed to such of its youth as are fully qualified to receive it.

Requirement of Summer Work.

Coming now to matters more closely related to the work of instruction, I will first consider the extension of the required work of the Institute courses for a period of four or five weeks into the summer. Such an extension can best be made, not by lengthening our present term, but by providing, in the summers at the end of the first two school years, summer schools which our regular students are required to attend and to which they will be admitted free of charge. The importance of this extension of our regular work can be fully appreciated only by those who are intimately acquainted with the difficulties and defects of our present system of instruction, but the main aspects of this matter can be readily understood. The educational problem of the Institute, as has already been stated, is to give students with only a high-school preparation a liberal education, a thorough training in fundamental scientific subjects, and sufficient technical knowledge to enable them to enter at once upon the practice of their profession. Under

the present conditions, as I have already said, we must for most of our students attempt to do this as far as possible in a period of four years. The opportunities of the four-year period have, however, not yet been fully utilized. Our summer vacations form one-third of the whole year; and during this time most of our younger students are unoccupied or are at work in places from which they derive no educational advantage. The assignment of even four or five weeks of the summer vacations after the first and second years to those portions of our work which consist largely in the acquirement of technical skill and experience, such as laboratory practice, shop-work, drawing, and work in the field and in industrial establishments, would so relieve the present overcrowded curriculum that an amount of good entirely out of proportion to the time gained could be accomplished. The time gained would, I am sure, be devoted by the Faculty not to further specialization in the engineering branches, but to some increase in general studies and to more thorough training in the fundamental principles of the sciences underlying the professional work. The attempt would be made to concentrate the attention of the student upon fewer subjects at one time, to demand more thought and less learning of lessons, and to emphasize important principles through the solution of numerous problems by the student. The pressure of the studies of the school year would be somewhat diminished; while the work of the summer school, being largely in laboratory, shop, or field, and concentrated upon one or two subjects, would not continue the mental strain to any great extent. The plan would involve increased expense to the Institute, for it would be necessary to pay the salaries of the instructors engaged in the summer schools for an additional month. Aside from this, the only important objection to it seems to be the added tax that it imposes upon the resources of certain students in forcing them to meet the expenses of living in Boston for a longer period and in shortening the time which they can devote to remunerative work. This makes it, in my opinion, out of the question to charge an additional tuition fee for such required

summer courses; but it is not a sufficient argument for postponing a step which is so essential to the effectiveness of our work.

Research Work by the Instructing Staff.

An extension of opportunities for investigation both in pure and applied science by members of our staff and by advanced students is a matter which, though secondary to the considerations directly affecting the instruction and general welfare of undergraduate students, is nevertheless of the greatest importance in its effect on the relation of the Institute to the scientific and technical development of this country. It ought to be our especial aim to get into the closest touch with the scientific problems of the manufacturer and the community, and to assist in the solution of them. Professors and instructors on our staff are already doing a vast amount of work in this direction, partly through the thesis work of students, and partly through their employment as experts. But this work is often performed under conditions which make a thorough-going investigation impossible; and, because of its personal character, it fails to be identified with the Institute and recognized among its contributions to scientific progress. In my opinion, we should in all departments give each of our assistants and instructors a reasonable proportion of free time for research purposes, we should afford him adequate laboratory facilities, and should then insist as a condition of his promotion and advancement in salary that he make and publish scientific or technical investigations. Almost all our instructors already have some available time that could be devoted to research work, so that the carrying out of this suggestion does not involve a proportionate increase in our staff. That time is, however, at present so limited, so disconnected, and so apt to be encroached upon by other work that the man feels little encouragement to enter upon an investigation. If that amount of time could be increased and made definite by the assignment of days or half-days for research work, there would result not only an incalculable gain to himself as a teacher, investigator, and scholar, but also

added reputation to the Institute because of its larger contributions to science.

Establishment of Research Laboratories.

Another method of promoting investigation work at the Institute is through the establishment of research laboratories in connection with the departments. For each such laboratory of an income of about $5,000 needs to be guaranteed for at least a few years. Two laboratories have already been started which are devoted to research in physical chemistry and in sewage disposal, and their contributions to pure science in the one case and to questions of municipal sanitation in the other have attracted much attention throughout the country. The Departments of Chemistry and of Geology have recommended two new laboratories of this kind,—a Research Laboratory of Applied Chemistry and a Research Laboratory of Physical Geology,—the former to be devoted to the study of chemical problems of general importance to the manufacturer, and the latter to the investigation of geological processes and disturbances of economic significance. The Departments of Applied Mechanics and Mechanical Engineering are also in need of research assistants to carry on more systematically such investigations as have long been in progress and to prepare the results for publication. The formal organization of research laboratories accomplishes much more than the same expenditure of money for uncorrelated investigations by the individual members of the departments. It calls attention to the activity of the Institute in this field, raises its scientific standing, attracts advanced students, who are often just as effective research workers as inexperienced assistants, offers facilities and inducements for advanced study and investigation to our younger instructors, and forms a nucleus of development in this important direction. I recommend that the Visiting Committees of the Departments give this matter their attention.

THE PROBLEMS OF STUDENT LIFE.

The problems of the outside activities of our students are, I believe, in the main solving themselves satisfactorily under the guidance of the administrative officers of the Institute. To our last President, Dr. Pritchett, is due in large measure the development of the conditions that make for a broader and fuller student life. His establishment of the Tech Union, which is the center of the social activities of students, his promotion of a rational system of athletics, his interest in the appointment of a Dean of the Faculty and a Medical Adviser, his institution of general convocations of students at which they are addressed by distinguished speakers, and other results of his own personal participation in student affairs, form a most worthy and enduring memorial of his service to the Institute. Credit for the progress in this direction must also be given to our Dean and our Bursar. The work of the former, as the general consulting officer for students, and of the latter in his sympathetic administration of his financial office and his effective management of the Tech Union, and the participation of both in the social gatherings of students have done much to develop a loyal, manly, democratic spirit such as exists in few colleges.

The Tech Union, great as are the benefits which it has brought to our student life, is, however, miserably inadequate as the social gathering place of our fourteen hundred students; and the same is true of the present temporary gymnasium as a means of providing for their physical welfare. One of the strong reasons for a prompt decision as to our future location is that the Walker Memorial Building can then be at once erected, whereby suitable social and dining halls and a properly equipped gymnasium will be provided.

There is, however, also a need of some provision for the housing of those of our students who cannot live at home or with friends, or in fraternity houses. Perhaps one-fifth of the whole body of students live in undesirable surroundings, in cheap boarding-houses, where opportunities for student fellow-

ship and for the development of a healthy social life do not exist. I strongly dissent from the view sometimes expressed that our obligations to the young men who spend with us four of the most critical, formative years of their lives are solely on the intellectual side; and the situation I have just mentioned is one, I think, for which we must soon find a remedy. It is one, too, which is especially appropriate for the Corporation and Alumni to deal with directly. In attacking this problem, it is desirable to proceed slowly and in an experimental way. A plan that might be followed is one which the Dean has suggested,—that of erecting two or three student houses, each accommodating twenty-five to thirty students, upon the Institute's vacant land in Brookline, adjoining the Athletic Field. The establishment of large dormitories accommodating a hundred or two hundred students does not offer a satisfactory solution of the problem; for there is a lack of the close fellowship and of the *esprit de corps* which is developed in smaller compact groups. The Greek-letter fraternities have demonstrated the type of student association which is attractive to young men. These have been extensively developed here during the past ten years; and, whatever may be true of them in the atmosphere of the college campus, they are on the whole successful here with the earnest kind of student who attends the Institute. The fraternity houses, however, owing to the large expense connected with the maintenance of such isolated private houses in the city, fail to provide for many of the students who most need such social opportunities as they afford. In buildings erected upon Institute land in the suburbs, it should be possible with proper financial management to provide board and room at a cost of six dollars a week, a sum which would be within the means of a much larger proportion of our students. There is every reason to believe that, with the interest in this undertaking already shown by the Dean and certain members of the Corporation, the Alumni, and the Faculty, this experiment would be successful.

CONCLUSION.

I might go on to discuss some of the more specific developments which it is desirable for the Institute to introduce, such as better provisions for training teachers in those branches of science and engineering with which we are most closely identified, definite arrangements for offering our professors leave of absence in the sabbatical years, or for a half-year in every four years, and the like; but I have already made too great a demand on your attention. In closing, permit me, however, to make one further suggestion. From my conversations with members of the Corporation I know that many of them earnestly desire to be of greater assistance to the Institute through closer contact with its work. I believe now that a great service might be rendered if special committees were appointed to promote some of the various lines of development to which I have alluded in this report. You have already appointed a Committee on the Site. It might be well to appoint also a Committee for the Promotion of the Welfare of Students, which could deal with the question of student houses, with other plans relating to their social, cultural, and physical life, and with further provision for scholarship aid to alleviate the hardships imposed by our high tuition. Still another Committee might be appointed for the Promotion of the Work of Instruction. This Committee would consider such matters as the extension of the personal conferences between instructors and students, the introduction of required summer work in the undergraduate courses, provision for research work by the junior members of the instructing staff, and enlargement of the scope of instruction in any desirable direction, it being understood that any such plan of educational development shall have first received the endorsement of the Faculty. These committees should, I believe, be in the closest relations with the Executive Committee with reference to all questions involving financial arrangements or radical changes of policy, and with the officers and committees of the Faculty in all matters relating to the

work of instruction or to the interests of students. They should frequently hold joint meetings with the representatives of the Faculty, thereby establishing the closer contact with that body which is so desirable. They should attempt to provide for the realization of such improvements as seem to them advisable and to that end should be given the necessary authority. The development of plans might well receive preliminary consideration in these committees alone, final actions of importance being taken in joint session with the Executive Committee in order to secure the proper correlation between the work of the different representatives of the Corporation.

ARTHUR A. NOYES.

DECEMBER 11, 1907.

Reports of Administrative Officers.

REPORT OF THE SECRETARY OF THE FACULTY.

The Faculty has considered the question of the allotment of time which would be set free by a reduction of the Modern Language requirement in any Course, which was referred to a committee during the previous year, and it has been decided that, of the time which would be released by the removal of one year of Modern Language, sixty hours should be added to the time now allowed for European History and English Literature.

In the Courses in Mechanical Engineering and Naval Architecture the second-year requirement in Modern Language has been discontinued. In the Course in Electrical Engineering it has been diminished by two hundred hours, a requirement of seventy hours remaining in the first term, which is to be devoted to an advanced course in the language taken during the first year.

The Faculty has approved the occasional substitution, in many of the professional Courses, of equivalent work in Spanish or Italian for the requirements in French or German, when adequate reasons are presented.

The special committee on Faculty Organization, appointed to report on a plan presented by the President, for changes in the conduct of Faculty business, has made its report, and the Faculty has adopted the following resolutions as an expression of its opinion on the general principles involved:

(1) That it is advisable that the Faculty *as a whole* continue to deal with questions of educational policy.

(2) That it is advisable that the Faculty through its officers and committees continue to carry on the work of administra-

tion, consultation, and correspondence, so far as these are connected with the studies, the registration, and the records of students.

(3) That it is advisable that the administrative work of the Faculty continue to be carried on by its officers and by its various standing committees rather than by a single administrative board or council chosen by the Faculty.

(4) That it is advisable that the Faculty meetings be relieved from certain business which can advantageously be transacted by committees, and that more definite provision be made for the preparation and presentation to the Faculty itself of matters which should receive its consideration.

(5) That it is advisable that in each term two or more conferences of the instructing staff of the respective departments be held for the discussion of matters of departmental policy and the improvement of methods of instruction, in order that interest and initiative may be developed in the instructing staff as a whole, and that a definite and recognized influence in matters of policy may be more generally exercised.

(6) That the Faculty, in response to the suggestion made by the President, express its appreciation of the desirability of some form of advisory relation between the Corporation and the Faculty, and its readiness to co-operate with the Corporation in the preparation of a plan for establishing such a relation.

Of other recommendations made by this committee, and approved by the Faculty, the following may be mentioned:

That there be a new standing officer of the Faculty known as Chairman.

That there be a new standing committee, known as the Committee on Faculty Business, whose duty it shall be to bring before the Faculty questions of general policy, reports of work at other institutions, and other matters for general discussion.

That there be a new standing committee known as the Committee on Courses of Instruction, to which all proposed changes in undergraduate course schemes shall be referred, before adoption by the Faculty.

Much attention has been given by the Faculty, and by a special committee of the Faculty, to the matter of courses of study for college graduates; and at a recent meeting of the Faculty schedules of elective studies were approved for graduate work in nearly all of the professional departments. Provision is also made whereby a college graduate who has completed essentially all of the work below the fourth year in some one of the professional Courses may arrange a two years' course leading to the degree of Master of Science, without taking the Bachelor's degree.

A special committee has been appointed to consider the question of requiring work during a portion of the summer vacation.

The Faculty has considered and approved the introduction of the general plan of providing, in close correlation with the instruction in first-year Mathematics and English, for regular conferences in which instructors in these two subjects shall meet their students individually or in groups of three or four students.

The Faculty Committee on Entrance Examinations is at present perfecting plans for obtaining more accurate information in regard to the fitness for our work of those who take our entrance examinations, in order that the examination records of *each* applicant may be supplemented by a statement from the school which he last attended.

ALLYNE L. MERRILL,
Secretary of the Faculty.

REPORT OF THE DEAN.

New students met the Committee of Advisers in the General Library on the Monday and Tuesday preceding the opening of the term, and through the co-operation of the undergraduates the work of registration was much facilitated. The student Young Men's Christian Association also assisted in

revising the lodging and boarding house lists, the Secretary of the society making personal investigation of many of the rooms on the city register.

A slight variation in the method of aiding first-year students in their choice of Course was introduced last year. At a general meeting of all first-year students, Professor Tyler outlined the characteristic features of each professional Course at the Institute, and gave sound advice in regard to a deliberate and thoughtful choice of the future line of work. Professor Noyes spoke on the importance of the general and non-professional studies at the Institute. Appointments were then made by the Dean for conferences with the Heads of Departments.

A general comment should be made on the change which has gradually taken place in the amount of initiative taken by the students in matters relating to their social life and outside activities. The very general use of the room known as the "Union" is beginning to show results. The men are much better acquainted with each other, and gatherings in connection with student activities have a larger attendance than formerly. The Institute Committee of the students is becoming a more effective and active body of men. The Walker and Civic Clubs and the different professional societies are doing more effective work in their chosen lines. Clubs based on the section from which the men have come tend to widen the acquaintance of students outside of their class or department, and it is gratifying to note that the students are in the habit of inviting members of the Faculty to unite with them informally at their various gatherings and suppers.

To the end of bringing about a closer personal relation between students and teachers, there has been organized in the Mathematical and the English Departments a series of individual conferences with reference to the instruction given in those departments. This movement is simply an extension and development of methods already employed by these two departments in their first-year instruction; but by the addition of new

instructors it has been possible in the Mathematical Department to have smaller sections, and to secure for every student in the first year time for personal conference with his instructor. This work in the Mathematical and the English Departments is simply an attempt to reinstate the conditions which prevailed at the Institute when the classes were smaller.

STATISTICS OF ILLNESS FOR THE SCHOOL YEAR 1906–07.

Fourth-year Class.

There were three hundred and eleven students, regular and special, in the fourth-year class. Of these twenty-two were reported ill during the school year 1906–07. Classified by diseases, there were the following cases: abscess, 1; boils, 1; broken ankle, 1; grippe, 1; indigestion, 2; operation on foot, 1; sprained ankle, 1; tonsillitis, 1; typhoid fever, 2; not specified, 11.

Third-year Class.

In this class there were three hundred seventy-six students, and of this number thirty-eight were reported ill during the year. The following cases were reported: fever, 2; fistula, 1; grippe, 3; hemorrhoids, 1; injury to hand, 1; measles, 2; nervous exhaustion, 1; neuralgia, 1; pleurisy 1; scarlet fever, 3; scarlatina, 1; tonsillitis, 1; trouble with eyes, 4; unspecified, 16.

Second-year Class.

The regular and special students in this class numbered three hundred thirty-two, of whom nineteen were reported ill during the year. There were the following cases: accident, 1; diphtheria, 1; grippe, 3; injury to hand, 1; laryngitis, 1; measles, 1; sore throat, 1; serious condition of blood, 1; tonsillitis, 3; trouble with eyes, 1; unspecified cases, 5.

First-year Class.

The first-year class numbered three hundred forty-six. Of this number thirty-one were reported ill during the school year. Classified by diseases there were the following cases: appendicitis, 1; blood poisoning, 1; broken arm, 1; cold, 1; dislocated elbow, 1; grippe, 4; inflammation of heel, 1; jaundice, 3; nose-bleed, 1; pleurisy, 1; scarlet fever, 1; sprained elbow, 1; tonsillitis, 1; trouble with eyes, 3; trouble with knee, 1; unspecified cases, 9.

SUMMARY.

	No. in Class.	No. Ill.	No. of Deaths.
Fellows and Graduates	32	0	0
Fourth Year	311	22	0
Third Year	376	38	0
Second Year	332	19	0
First Year	346	31	0
Total	1,397	110	0

ALFRED E. BURTON,
Dean.

REPORT ON THE TECH UNION.

The Tech Union, started some years ago by Dr. Pritchett, with an idea of giving to the students something of social life, which had in the past been so lacking at the Institute, has more than justified all expectations. Previous to the establishment of the Union there were no rooms where students could meet socially, and the class and society dinners held at the hotels were practically the only meetings of a social nature for the students, and this privilege was denied many of the societies because of the expense. An interest in some form of athletics brought men together, but the number was comparatively small. There were, in fact, few of the opportunities offered by other institutions of learning for the men to get together, to know each other, to receive the benefit that comes from association with their fellow-students. The Union has changed all this, and has done more for the students socially, more to create a love of the Institute and a loyalty for it than many of us realize. Poor as the quarters are at the Union, yet, hung with the gifts of various graduating classes, that show a loving loyalty; the Tech Show pictures that remind us of many happy hours; and the trophies of the Athletic Field, reminders of friendly class contests and of joyous victories over other rivals, the Union has come to mean much to our undergraduates. All class dinners are held there, Field day, Show and Tech Fresh-

man dinners; and the Young Men's Christian Association Receptions are now annually given there, while the Instructors Club and many of the Societies hold monthly meetings. For three years most of the Saturday evenings have been given up to a "Kommers" with a twenty-five cent dinner, at which a number of well-known men have talked to the students on various subjects of general interest, and these meetings have been largely attended, 160 to 200 being not unusual. A daily noon lunch is served in the main room, which is well patronized: student waiters are employed, who are thus given a chance to help out their expenses. For several years past on Christmas Eve an entertainment with refreshments and some small gifts has been furnished by friends of the students, at which some hundred and seventy-five students have been present, thus getting some little of the Christmas cheer. During the past year there have been served 23,703 noon lunches, or an average of 140 per day, at an average price to the students of nineteen cents, and seventy-six class and society dinners averaging thirty-nine cents. The Union is also used for all the Tech Show rehearsals, for business meetings of clubs and societies. There are, in fact, few afternoons and evenings when some use is not made of the rooms by students. This work of the Union has been most pleasant to those having it in charge, and we cannot but believe that all at the Institute are beginning to feel that it is accomplishing much good. I believe it has become of sufficient importance, and has achieved enough success to justify the authorities of the Institute in taking charge of the work officially, and in making some definite provision for its continuance and oversight in the future.

FRANK H. RAND.

REPORT OF THE INSTRUCTOR IN PHYSICAL TRAINING.

During the past year there have been no important changes in this department. The work has been carried on along the same general lines as before.

At the beginning of the year a physical examination was given to all students who desired it, and about eighty men presented themselves. These men were given anthropometric charts, showing their physical development and condition in comparison with the tabulated reports of hundreds of other students of similar ages.

Regular gymnasium work began November 12th. There were two classes a day, on Mondays, Wednesdays, and Fridays from 4.10 until 5.00, and from 5.10 until 6.00 P.M. The classes were fairly well attended, and much interest was taken in the work throughout the year. The regular gymnasium work closed April 13th, and the annual gymnastic exhibition was very successfully given.

A second physical examination was given to about fifty men so that their exact improvement might be noted.

The Cabot medals for improvement in Physical Training were awarded to the following men: Everett E. Turkington, '07; John F. Johnston, '07; George Schobinger, '08; Eleazar Myers, '08; and Frederick M. Heidelberg, '09.

WINFIELD C. TOWNE,
Instructor in Gymnastics.

REPORT OF THE MEDICAL ADVISER.

There have been no important changes in the medical work at the Institute in the last year. Consultation hours have been held on two afternoons a week throughout the year; and, as usual, the students have fully occupied this time, and the time of consultation had frequently to be extended

to accommodate all those who came for advice. The average extra time needed was forty-five minutes more than the appointed hour. For a small part of the year no extra time was required, but on several occasions one and a half to one and three-quarters extra hours were needed. The following table gives the number of office visits made and the number of students seen. A few figures of previous years are given for comparison:—

	1905.	1906.	1907.
Total number of office visits made	406	345	409
Total number of different students seen	191	195	196
Greatest number of students seen per day			11
Least number of students seen per day			2
Average number of students seen per day			7
Number of students making more than one visit			48

The amount of the medical work remains very constant from year to year, and under the present arrangement does not seem likely to increase in the future. The great majority of the men made only a single visit, usually for the treatment of some acute and promptly curable condition. The men who came more than a few times were usually patients who required repeated dressings of some surgical injury.

A classified list of the diseases treated and the number of each will be found at the end of the report. A great variety of illnesses was treated, the most numerous being diseases of the digestive apparatus, of the nose and throat, and surgical cases. About a dozen men suffered from severe illness, such as appendicitis, scarlet fever, malaria, jaundice, pleurisy, Bright's disease; two men had to leave the Institute on account of pulmonary tuberculosis; a small number of students were referred to specialists for the treatment of the eye, ear, and skin. A small number of students were referred to the Institute free beds at the Massachusetts General Hospital for the treatment of severe acute illness.

In addition to the work at the Institute office, I have seen about sixty men at my private office and a much smaller number

at their homes. In addition to sick students, ten healthy men were examined for the United States Civil Service or for athletic teams.

The Medical Adviser wishes to call attention once more to the fact that there are a certain number of men each year who get tired and whose work suffers early in the fall term, either because they have had little or no vacation in the summer or because they have begun their work with too great enthusiasm and too little regard to their health. It seems very desirable that the officers of instruction who have a chance to advise the students about their work should tell them that some rest in the summer is necessary after an active year's work, and also point out that the year's work is really a long distance run, not a sprint race, and that they must not use up too much energy at the start.

The number of contagious diseases at the Institute this year is, as usual, very small. The Medical Adviser is supposed to see and approve of the return of every man who has been out with a contagious disease, to prevent these men from cutting short the necessary period of quarantine. The men often do not report to the Medical Adviser on their return, and the good results in spite of the negligence must be due to the care of their home physicians in advising their return.

This year for the first time each man who asked to be excused from Military Drill on account of illness or disability was required to report promptly to the Medical Adviser for his opinion in the matter. This has increased the work of the medical office but little, and has proved useful in several ways, by bringing some men to me who really needed advice about their health, and by preventing the absence of others from drill without a good excuse.

Three talks on personal hygiene were given by the Medical Adviser to the whole Freshman class. With increased experience it has been possible to adapt these talks more and more each year to the definite needs of the student body. The following subjects have been taken up: bathing, exercise, food, sleep,

care of the eyes, the use of tobacco and alcohol, minor ailments, and the prevalence and dangers of venereal disease.

This last year I have included a talk upon the emergency treatment of injuries to which some of the students are especially exposed while they are at the Institute and afterwards, in the mine, the chemical laboratory, the machine shop, or the field. The subjects taken up included suffocation or poisoning by gases and the emergency treatment of burns, cuts, bruises, and hemorrhage; the method of carrying on artificial respiration was demonstrated.

This year for the first time there were made up under my direction for use in the mechanical and other laboratories several boxes containing gauze, absorbent cotton, bandages, and simple antiseptics to be ready for the emergency treatment of slight accidents such as cuts, bruises, burns, etc.

DISEASES TREATED BY THE MEDICAL ADVISER.

Stomach and Bowels	32	Genito-urinary Cases	17
Nose and Throat Cases	36	Lungs	14
Skin	17	Heart	11
Eye	18	Ear	5
Surgical Cases	56	Miscellaneous	38
Specific Infectious Diseases	15		

FRANKLIN W. WHITE,
Medical Adviser.

REPORT OF THE LIBRARIAN.

During the year ending September 30, 1907, the total number of items added to the record of accessions in the Libraries of the Institute amounts to 4,890, an increase of 899 over last year. The following table shows what proportion of these accessions were obtained by purchase, by binding, and by gifts:—

TOTAL ACCESSIONS, 1906–1907.

By Purchase	1,353
By Binding	1,407
By Gift, Volumes	1,028
By Gift, Pamphlets	1,102
Total	4,890

The cost of the purchase of books and the administration of the Libraries, exclusive of salaries, as shown by bills approved in this office, amounts to $6,059.94, this sum being composed of the following items:—

BILLS APPROVED 1906–07.

Books and Binding	$4,907.20
Periodicals	1,849.27
Supplies	303.47
Total	$6,059.94

The net accessions to the Library, calculated by deducting from the gross accessions the number of books lost or destroyed, and of books or pamphlets counted twice, amount to 3,466 volumes, 684 pamphlets, and 148 maps, an increase of 75 volumes, 260 pamphlets, and 12 maps over last year.

The apparent large discrepancy between the gross accessions and the net accessions is due to the binding of a large number of pamphlets for the Geological Library, so that in that Library there appears to be a net decrease of 162 pamphlets. When a pamphlet is bound, it becomes, technically speaking, a volume, and these pamphlets, after being bound and being counted as volumes, are deducted from the total accessions, as they had been previously recorded in the list of pamphlets.

The particulars of the growth of the several Libraries of the Institute in numbers of volumes, pamphlets, and maps, with the amount expended for each Library, and the present total contents, is shown in the following tables:—

TABLE OF THE NET INCREASE WITH THE COST OF THE SAME DURING THE YEAR 1906–07, AND THE TOTAL CONTENTS OF THE LIBRARIES OF THE INSTITUTE, SEPTEMBER 30, 1907.

LIBRARIES.	Net Increase.				Total Contents.	
	Volumes.	Pamphlets.	Maps.	Cost.	Volumes.	Pamphlets and Maps.
General Library:						
General	155	31	—	$107.86	7,239	5,069
English	104	—	—	136.15	3,476	44
Military Science	27	—	—	2.00	367	9
Walker Memorial	—	—	—	—	485	—
Other Departments	8	—	—	43.20	47	1
Totals General Library	294	31	—	$289.21	11,614	5,123
Architecture	105	10	—	282.17	4,040	251
Biology	133	86	—	261.84	3,403	720
Chemistry	391	171	—	823.65	10,686	2,035
Electrical Engineering	92	16	—	192.62	1,317	72
Engineering	873	303	—	1,253.45	13,610	4,876
Geology	458	—162*	147	130.82	3,220	2,811
History and Economics	396	23	—	377.48	12,291	3,588
Margaret Cheney Room	7	—	—	17.55	676	13
Mathematics	99	45	—	179.11	1,743	262
Mining	310	54	1	511.33	4,500	723
Modern Languages	48	6	—	30.96	1,719	56
Naval Architecture	43	13	—	125.82	1,238	119
Physics	217	88	—	431.19	8,104	1,165
Totals	3,466	684	148	$4,907.20	78,161	21,814

The total number of cards now in the General Catalogue is 86,269, there having been added during the year 5,469 cards. There were 1,268 orders issued for the purchase of books and periodicals, and 2,124 orders were sent to the binders. The following table will show the circulation of books outside the Library, so far as a record has been kept:—

*Excess of pamphlets bound over those received during the year. A pamphlet when bound is deducted from the number of pamphlets and added to the volumes.

CIRCULATION.

General Library	890 volumes.
Architectural Library	1,806 "
Biological Library	211 "
Chemical Library	796 "
Engineering Library	790 "
Mining Library	464 "
Physics Library	1,569 "

The number of serial publications received during the year has increased from 1,042 to 1,079, and the estimated cost from $2,690.87 to $2,814.37, of which $1,966.24 is chargeable to the appropriation for periodicals.

The number of periodicals and other serials sent to each department and the amounts chargeable to the several accounts are indicated on the following table. The costs are estimated from bills approved during the year.

TABLE OF PERIODICALS AND OTHER SERIAL PUBLICATIONS RECEIVED DURING THE YEAR 1906–07, CLASSIFIED BY DEPARTMENTS AND METHOD OF PAYMENT.

LIBRARIES.	Number Received.					Estimated Cost.			
	Gifts.	Charged to Department.	Periodical Account.		Totals.	Dept. Account.	Periodical Account.		Totals.
			Subs.	Exch.			Subs.	Exch.	
General	42	18	29	31	120	$51.92	$101.26	$52.00	$205.18
Architecture	9	6	32	2	49	25.71	148.00	2.00	175.71
Biology	33	21	33	9	96	90.14	256.75	8.00	354.89
Chemistry	12	47	31	15	105	170.22	204.36	27.00	401.58
Electrical Engineering	7	7	14	5	33	10.85	72.69	10.00	93.54
Engineering	46	72	54	66	238	178.92	220.51	121.00	520.43
Geology	14	8	11	12	45	28.28	91.04	18.00	137.32
History and Economics,	62	47	41	5	155	101.88	141.18	8.00	251.06
Margaret Cheney Room,	—	6	—	—	6	17.20	—	—	17.20
Mathematics	2	4	16	2	24	9.97	73.28	3.00	86.25
Mining	11	10	25	31	77	29.49	105.56	67.00	202.05
Modern Languages	3	1	18	1	23*	2.16	79.62	2.00	83.78
Naval Architecture	5	11	6	4	26	45.92	20.23	8.00	74.15
Physics	17	17	23	25	82	78.47	104.76	28.00	211.23
Totals	263	275	333	208	1,079	$841.13	$1,619.24	$354.00	$2,814.37

*10 kept in the General Library.

In the Institute of Technology the division of the Libraries into Departmental Libraries is carried out to its fullest extent, and it is often asked how much duplication this involves. It is difficult to record this for the books purchased, but the record of the daily receipt of periodicals furnishes an easy means of determining the amount of the duplication of that class of publications. During the past year two or more copies have been received of thirty-five periodicals, the additional copies costing $136.46.

The General Library has been open for readers during term time until 10 o'clock in the evening. The average attendance for 112 days from 5 to 7 P.M. was 10.2 per day, and 5.3 per day from 7 to 10 P.M., the total attendance for these periods being 1,142 and 599, respectively. The total number of days that the Library was open in the evening was greater than this, but the record of attendance prior to December 1 is unavailable.

Gifts of books are frequently received by libraries, but it is rare for any one to remember that the cost of placing a book on the shelf equals, on the average, the cost of purchasing; and for that reason, probably, gifts towards the maintenance of a library are seldom received. It is, therefore, a special pleasure to record two such gifts from our constant benefactor, Mrs. William Barton Rogers. During the spring she gave us $500 for the binding of books and pamphlets in the Geological Library, where a large number of unbound books had acccumulated. And at the close of the year covered by this report she presented for use in the Librarian's office a Hammond typewriter of the latest and most approved pattern, which was an especially welcome addition to the equipment at that particular time.

Gifts of books to the Library are always welcome, and among the many valuable ones that have been received during the year the following should be especially noted. From Dr. Charles G. Weld we have received 12 volumes on Naval Architecture; from General H. L. Abbot, the valuable "Report of the Board of Consulting Engineers for the Panama Canal," with text and maps; from the Council of the Royal Society, London, 6 vol-

umes of their "Proceedings," including 5 of the earliest ones; from Messrs. William Denny & Brothers, Dumbarton, Scotland, a volume on "Turbine Steamers"; from Francis H. Appleton, Esq., of Salem, "Ship Registers of Salem and Beverly, 1789–1900"; from the Hon. John A. Sullivan, M.C., Moore's Digest of International Law, 8 volumes; from the Trustees and Family of the late Dr. James Young, of Kelly, Glasgow, Scotland, "Bibliotheca Chemica," 2 volumes; from Henry M. Whitney, Esq., 14 volumes of mining journals; from Mrs. Rogers, 8 volumes on various subjects; from Mr. Louis Weissbein, of Boston, 3 volumes on Art and Architecture; from M. J. Sturn, Esq., of Chicago, one volume on the Organization, Construction and Management of Hospitals.

Professors Breed, Hosmer, Gill, and Derr, and Messrs. J. R. Freeman, W. T. Hall, and G. W. Rolfe have contributed bound volumes of their writings; and Messrs. D. C. Heath & Co. and G. P. Putnam & Sons have contributed various text-books in the modern languages.

It is the constant endeavor of the Librarian to improve the administration and equipment of the Libraries so far as funds and opportunity will permit. An important step in this direction was completed during the year 1906–07. This was the copying of the cards in the old catalogue for the Chemical Department and the completion of the subject catalogue of the Chemical Library. This was accomplished largely through the skill and industry of the Assistant-in-Charge, Miss Harriet J. Buck. Unfortunately, ill-health has prevented Miss Buck's return to the Institute this year, but we are fortunate in having Miss Florence G. Finley, S.B. (Simmons), to take her place. Three of the Libraries of the Institute now have complete subject catalogues. To complete the subject catalogue for all the Libraries of the Institute will require a number of years, but progress is being made in that direction as rapidly as circumstances will permit.

ROBERT P. BIGELOW,
Librarian.

REPORT OF THE REGISTRAR.

The total number of members of the Instructing Staff as shown by the Annual Catalogue this year, including those at the Mechanical Laboratories, but excluding the Research Associates and Assistants, and those who are announced annually as lecturers only, is 210. Counting all, there are 253. Not taking into account the Research Associates and Assistants and Lecturers, the number of members of the Instructing Staff to that of students in regular attendance bears the proportion of 1 to 6.7. Last year it was 1 to 6.9.

The number of students has risen, this year, from 1,397 to 1,410. The gain is in the fourth-year and second-year classes. In the third-year and first-year there is a loss in the number of students. The number of regular students is larger than that of last year, and the ratio of regular students to specials is likewise larger.

The number of new students is 527, as compared with 535 last year. The percentages of new students, for these two years, are 37 and 39, respectively.

The number of college graduates enrolled is 182, which includes twenty candidates for advanced degrees. The number last year was 200. The numbers of colleges and universities represented by students this and last year, including both graduates and non-graduates, are 85 and 88, respectively. The number of new students from other colleges this year is 155, as compared with 154 last year.

Instead of the slight drop on the professional Courses which was noted last year, there has been a gain in each one of the courses, except Civil Engineering, where the number is the same as last year, and Naval Architecture. There has been a slight loss in the number who are enrolled in the Department of Naval Architecture. For the first time, regular students are registered in the Course of General Science.

Forty-three states of the Union and one territory besides

the District of Columbia, Hawaii, Porto Rico, and the Philippines, are represented on the list of students. While North Carolina, Idaho, and Louisiana are not represented at the Institute by students this year, Arkansas, New Mexico, and Oklahoma, each of which had no representative last year, are now represented. The number of foreign students at the Institute (80) has again risen, and in place of the 29 foreign countries represented last year at the Institute there are now 31.

Of the total number of 1,410 resident students, 781 are from Massachusetts, or 55.5 per cent. of the whole, or 0.5 per cent. more than last year or the year before. All the counties of the state send students to the Institute.

Of the cities and towns of the state, 128 are on the list. A table shows the number of cities and towns of each county sending five or more students, and also gives the aggregate number from each county. Middlesex County sends 238; Suffolk, 218; Essex comes third with 105; Norfolk, fourth with 95.

The registration in the Summer School (283) was greater than last year by 54: the number of students (58) from other colleges or schools was larger by 19 than last year. There was a marked increase in the number of registrations for the purpose of making up failures or deficiencies, while there was a decrease in those to anticipate work. Courses were anticipated principally in Mechanic Arts, Descriptive Geometry, Architectural Design, Languages, Mechanical Drawing, and Surveying.

The total number of students assisted from Institute funds during the past year was 158, and the amount awarded was $18,500. In addition to this, 65 students were aided by the state, of whom 45 were not aided by the Institute; therefore, 203 students received scholarship assistance.

The number in the graduating class of last June was 208. Of these, 127 received the degree after attending the Institute four years. Of the 81 who received the degree in other than four years, 52 were students from other colleges who attended the Institute from one to three years. Again it is noticeable,

as it was last year, that somewhat more than one-half of the college graduates spent two years in completing their courses, and more than one-quarter spent three years. Only two received the degree in less than two years.

This year a study has been made of the distribution among the four classes, of the students who have entered the Institute from other colleges. Of these 155, twenty-one per cent. spent one year at college; nineteen per cent. spent two years; fourteen per cent. three years; and thirty-nine per cent. four years. Of the 33 who spent one year at college, 22 entered the second year, and 11 the first year. Of the 30 who spent two years at college, 9 entered the third year, 19 the second year, and 2 the first year. Of the 21 who spent three years at college, 16 entered the third year, and 5 the second year. Of the 61 who spent four years at another college, 3 entered the fourth year, 44 the third year, 13 the second year, and 1 the first year. Irrespective of the years spent at college, of the 155 who entered, 4 entered the fourth year, 73 the third year, 62 the second year, and 15 the first year.

As the work of the clerical force organized by the Income Fund Committee was completed, except for the collection of subscriptions, this office was transferred to the Alumni Association to form the office of this society. The Institute has assigned the use of one of the rooms in the Rogers Building to this office, and regular work has been carried on during the past year. This office has co-operated with the Registrar's Office in maintaining catalogues of the graduates and former students of the Institute. Three catalogues are maintained, arranged alphabetically, by classes, and geographically.

A mailing system has been developed, which is of value both to the Institute and to the Alumni Association, and has been used by various class associations. This office has also assisted the Registrar's Office at the opening of the terms and during the examination periods, when the pressure of work is considerably greater than during the rest of the year.

THE CORPS OF INSTRUCTORS.

The following table shows the distribution among the several classes of instructors, in comparison with last year:—

	1906–07.	1907–08.
Professors	39	43
Associate Professors	18	18
Assistant Professors	21	25
	78	86
Instructors	69	72
Assistants	52	52
	121	124
Research Associates	8	8
Research Assistants	3	3
	11	11
Lecturers	31	32
Total	241	253

STUDENTS BY CLASSES.

The aggregate number of students for 1907–08 is divided among the several classes, as follows:—

Resident Fellows	3
Candidates for advanced degrees	17
Regular students, Fourth Year	208
" " Third "	187
" " Second "	211
" " First "	276
Special students	508
Total	1,410
Non-resident Fellows	5

The following table shows the division of the whole body of students among the several years:—

Class.	Regular.	Special.	Total.
Resident Fellows and Advanced Students	20	—	20
Fourth Year	208	118	326
Third Year	187	179	366
Second Year	211	160	371
First Year	276	51	327
Total	902	508	1,410

THE COURSES OF INSTRUCTION.

The following table presents the number of the regular and the special students in the second, third, and fourth years, by Courses:—

Year.		Civil Engineering.	Mechanical Engineering.	Mining Engineering and Metallurgy.	Architecture.	Chemistry.	Electrical Engineering.	Biology.	Physics.	General Science.	Chemical Engineering	Sanitary Engineering	Geology.	Naval Architecture	Total.
4th Year Class	Reg.	48	57	15	14	12	31	4	3	—	13	3	—	8	208
	Sp.	22	13	16	19	19	25	1	3	—	5	5	—	—	118
3d Year Class	Reg.	35	43	11	12	5	44	4	3	1	11	9	—	9	187
	Sp.	39	30	25	12	13	31	5	5	1	9	3	—	6	179
2d Year Class	Reg.	38	49	27	5	5	48	2	6	—	14	11	—	6	211
	Sp.	28	34	24	20	9	21	1	—	—	7	8	—	8	160
Total . . .	Reg.	121	149	53	31	22	123	10	12	1	38	23	—	23	606
	Sp.	89	77	65	51	31	77	7	8	1	21	16	—	14	457
		210	226	118	82	53	200	17	20	2	59	39	—	37	1,063

The following table shows the number of regular students in the foregoing table, in comparison with the corresponding figures for the next ten preceding years:—

Year.	Civil Engineering.	Mechanical Engineering.	Mining Engineering and Metallurgy.	Architecture.	Chemistry.	Electrical Engineering.	Biology.	Physics.	General Course.	Chemical Engineering.	Sanitary Engineering.	Geology.	Naval Architecture.	Total.
1897	109	119	38	71	60	90	8	9	10	36	7	1	26	578
1898	93	108	52	64	64	94	6	8	12	38	7	1	33	574
1899	99	113	60	53	58	84	8	7	11	30	14	1	38	575
1900	89	127	69	53	50	87	6	4	8	34	17	1	38	582
1901	102	129	76	40	35	96	6	13	9	30	14	1	39	590
1902	129	133	83	43	58	118	2	20	9	30	12	1	65	703
1903	132	161	91	53	55	126	4	23	6	27	14	1	72	765
1904	140	158	77	41	46	98	4	13	—	32	22	1	49	681
1905	134	149	54	44	36	100	1	13	—	29	13	—	38	611
1906	119	131	39	39	24	101	4	11	—	30	18	—	25	541
1907	121	149	53	31	22	123	10	12	1	38	23	—	23	606

GRADUATES BY YEARS AND COURSES.

Year.	Civil Engineering.	Mechanical Engineering.	Mining Engineering.	Architecture.	Chemistry.	Metallurgy.	Electrical Engineering.	Natural History or Biology.	Physics.	General Course.	Chemical Engineering.	Sanitary Engineering.	Geology.	Naval Architecture.	Total.
1868	6	1	6	–	–	–	–	–	–	1	–	–	–	–	14
1869	2	2	–	–	1	–	–	–	–	–	–	–	–	–	5
1870	4	2	2	–	1	–	–	–	–	1	–	–	–	–	10
1871	8	2	5	–	2	–	–	–	–	–	–	–	–	–	17
1872	3	1	5	–	3	–	–	–	–	–	–	–	–	–	12
1873	12	2	3	1	7	–	–	–	–	1	–	–	–	–	26
1874	10	4	1	1	–	–	–	–	–	2	–	–	–	–	18
1875	10	7	6	1	1	–	–	–	1	2	–	–	–	–	28
1876	12	8	7	–	5	1	–	2	3	4	–	–	–	–	42
1877	12	6	8	4	2	–	–	–	–	1	–	–	–	–	32
1878	8	2	2	3	3	–	–	–	–	1	–	–	–	–	19
1879	6	8	3	1	3	–	–	1	1	–	–	–	–	–	23
1880	3	–	3	–	1	–	–	–	–	1	–	–	–	–	8
1881	3	5	6	3	8	–	–	1	–	2	–	–	–	–	28
1882	2	5	5	3	6	–	–	1	1	1	–	–	–	–	24
1883	3	7	5	1	3	–	–	–	–	–	–	–	–	–	19
1884	5	6	13	–	12	–	–	–	–	–	–	–	–	–	36
1885	4	7	8	2	4	–	2	–	–	1	–	–	–	–	28
1886	9	23	7	1	7	–	10	1	–	1	–	–	–	–	59
1887	10	17	8	1	9	–	8	1	1	3	–	–	–	–	58
1888	11	25	4	5	10	–	17	3	1	1	–	–	–	–	77
1889	14	24	5	3	8	–	17	1	1	2	–	–	–	–	75
1890	25	28	3	5	13	–	18	3	2	6	–	–	–	–	103
1891	18	26	4	6	11	–	23	3	3	1	7	–	1	–	103
1892	22	26	4	13	7	–	36	6	1	7	4	6	1	–	133
1893	25	30	5	2	8	–	41	2	–	6	8	–	2	–	129
1894	21	31	4	14	11	–	33	1	3	5	12	3	–	–	138
1895	25	30	3	15	14	–	33	–	2	4	11	4	–	5	144*
1896	26	34	10	24	17	–	48	3	3	7	7	4	3	5	190*
1897	25	40	7	16	20	–	33	2	3	7	12	4	1	9	179
1898	32	41	7	29	25	–	33	3	4	6	9	3	–	7	199
1899	30	37	9	22	22	–	32	2	2	1	10	1	–	8	173*
1900	32	34	21	21	19	–	23	3	3	5	11	4	–	9	185
1901	37	39	18	21	17	–	25	1	1	6	14	4	1	16	200
1902	24	46	14	18	14	–	35	5	3	3	9	7	–	14	192
1903	26	37	27	15	13	–	39	1	4	1	10	4	1	12	190
1904	34	45	32	24	15	–	34	3	13	5	7	2	1	17	232
1905	46	54	26	12	23	–	31	3	3	3	13	5	1	24	244
1906	47	69	38	22	21	–	37	2	7	–	10	6	–	19	278
1907	36	52	22	21	10	–	32	–	5	–	14	3	2	10	207
Totals	688	863	366	330	376	1	640	54	71	96*	168	60	14	155	3,877*
Names counted twice, students graduating in two different years . . .															17
Bachelors of Science															3,860*
Masters of Science, not included in the above															26
Doctors of Philosophy, not included in the above															1
Total . . .															3,887*

* Deducting names counted twice (students graduating in two courses).

YEARLY REGISTRATION.

The following table shows the registration of successive years from the foundation of the Institute:—

Year.	No. of Students.	Year.	No. of Students.
1865–66	72	1887–88	720
1866–67	137	1888–89	827
1867–68	167	1889–90	909
1868–69	172	1890–91	937
1869–70	206	1891–92	1,011
1870–71	224	1892–93	1,060
1871–72	261	1893–94	1,157
1872–73	348	1894–95	1,183
1873–74	276	1895–96	1,187
1874–75	248	1896–97	1,198
1875–76	255	1897–98	1,198
1876–77	215	1898–99	1,171
1877–78	194	1899–1900	1,178
1878–79	188	1900–1901	1,277
1879–80	203	1901–1902	1,415
1880–81	253	1902–1903	1,608
1881–82	302	1903–1904	1,528
1882–83	368	1904–1905	1,561
1883–84	443	1905–1906	1,466
1884–85	579	1906–1907	1,397
1885–86	609	1907–1908	1,415
1886–87	637		

The special students this year constitute thirty-six per cent. of the whole body, as against forty-one per cent. last year and forty-two per cent. the year before.

The following table shows, by classes and by Courses, the number of regular students who have registered themselves as electing to distribute the required studies and exercises over the period of five years:—

Year.	Total.	Course.												
		I.	II.	III.	IV.	V.	VI.	VII.	VIII.	IX.	X.	XI.	XII.	XIII.
1st . . .	2	–	–	–	–	–	–	–	–	–	–	–	–	–
2d . . .	4	–	3	–	–	–	1	–	–	–	–	–	–	–
3d . . .	6	–	2	1	–	–	2	–	–	–	–	–	–	1
4th . . .	10	3	2	1	1	1	1	–	1	–	–	–	–	–
5th . . .	2	1	–	–	–	–	–	1	–	–	–	–	–	–
	24	4	7	2	1	1	4[a]	1	1	–	–	–	–	1

The following is the number of students, either regular or special, pursuing certain leading branches of study, in each of the four years:—

	First Year.	Second Year.	Third Year.	Fourth Year.	Total.
Mathematics	363	383	150	3	899
Chemistry	344	112	96	78	630
English	328	292	43	–	663
French	211	–	26	–	237
Physics	–	366	327	54	747
German	94	57	56	–	207
Mechanic Arts . . .	–	146	54	84	284

The following table exhibits for ten years the distribution of the total number of students among two classes: first, those students whose names are found upon the Catalogue of the year preceding; and, secondly, those whose names appear first upon the Catalogue of the year to which the statement relates:—

Year.	(1) Total No. of Students.	(2) No. of Students in the catalogue of the previous year who remain in the Institute.	(3) No. of New Students entering before issue of catalogue.	(4) Of those in column (3) the following number are regular First-year Students.	(5) No. of New Students not of the regular First - year Class.
1898–99	1,171	769	402	278	124
1899–1900	1,178	764	414	275	139
1900–1901	1,277	789	488	312	176
1901–1902	1,415	844	571	396	175
1902–1903	1,608	949	659	432	226
1903–1904	1,528	1,042	486	249	237
1904–1905	1,561	986	575	295	280
1905–1906	1,466	984	482	213	269
1906–1907	1,397	862	535	272	263
1907–1908	1,415	888	527	273	254

GRADUATE STUDENTS.

Twenty graduates of colleges or universities are, this year, candidates for advanced degrees. One hundred sixty-six are pursuing undergraduate courses. The colleges and universities represented by the one hundred eighty-six graduates are shown in the following table:—

Colleges and Universities.

Acadia	1	Marietta	1
Adelbert	1	Marquette	1
Adrian	1	Maryland Agricultural	1
Albright	1	Massachusetts College of Pharmacy	1
Allegheny	1	Massachusetts Institute of Technology	10
Amherst	4	Missouri	1
Anatolian	2	National (Buenos Ayres)	1
Arkansas	1	Nebraska	1
Armour Institute of Technology	2	Northwestern	1
Beloit	1	Ohio Wesleyan	1
Bethany	1	Oklahoma	1
Boston College	1	Oregon	1
Bowdoin	4	Pennsylvania	2
Brown	5	Princeton	11
Bucknell	1	Purdue	1
Canisius	1	Randolph-Macon	1
Central Technical, London University	1	Richmond	1
Central	1	Rochester	2
Charleston	1	Rose Polytechnic	1
Chicago	4	Sacred Heart	1
Colby	2	Saint Johns	1
Colorado	2	Saint Louis	3
Cooper Union	1	Saint Marys	1
Cornell	1	South Carolina	1
Dakota Wesleyan	1	South Dakota	1
Dalhousie	2	Southwestern Presbyterian	1
Denison	1	Spanish	1
De Pauw	2	Texas	6
Fairmount	1	Throop Polytechnic	1
Franklin and Marshall	1	Trinity, Cambridge University	1
Georgetown University	1	United States Naval Academy	16
Hamline	1	Virginia	2
Hampden-Sidney	1	Virginia Polytechnic	1
Harvard	16	Washington and Jefferson	4
Havana (Cuba)	1	Wesleyan	2
Haverford	1	West Virginia	1
Illinois	1	Whitman	2
Indiana	2	Williams	4
Iowa	3	Wisconsin	1
Iowa State	1	Yale	6
Johns Hopkins	6		
Kansas	1		187
Lehigh	1	Counted twice	1
Leland Stanford Junior	1	Total	186
Louisiana	1		

NEW STUDENTS FROM OTHER COLLEGES.

This table shows the distribution of new students from other colleges among the classes of the Institute and the number of years previously spent at college:—

Class, by Year, Joined at Institute.	One year at Coll.	Two years at Coll.	Three years at Coll.	Four years at Coll.	Five years at Coll.	Six years at Coll.	Total.
First	11	2	—	1	—	1	15
Second	22	19	5	13	3	—	62
Third	—	9	16	44	4	—	73
Fourth	—	—	—	3	—	1	4
Graduate	—	—	—	—	1	—	1
Total	33	30	21	61	8	2	155

WOMEN STUDENTS.

The number of women pursuing courses with us is thirteen. Of these one is a college graduate. Of the total number three are regular students of the third year, and one of the second year. Nine are special students. Of the four regular students of the upper classes three take Course IV., Architecture; and one, Course V., Chemistry. Of the special students, seven devote themselves to Architecture and one to Chemistry, while one is a first-year student.

AGES OF STUDENTS.

The next table exhibits the ages of our students upon entrance, after taking out five who are repeating the first year, and nine persons of unusual ages. These deductions leave two hundred sixty-two as the number of students whose ages have been made the subject of computation.

Period of Life.	1906–1907.		1907–1908.	
	Half-year Groups.	Yearly Groups.	Half-year Groups.	Yearly Groups.
16 to 16½ years	—	—	1	—
16½ to 17 "	5	5	4	5
17 to 17½ "	14	—	14	—
17½ to 18 "	29	43	34	48
18 to 18½ "	51	—	45	—
18½ to 19 "	49	100	54	99
19 to 19½ "	51	—	41	—
19½ to 20 "	33	84	30	71
20 to 20½ "	12	—	14	—
20½ to 21 "	11	23	9	23
21 to 22 "	8	8	16	16
	263	263	262	262

The results appear in the table above in comparison with the corresponding results of 1906–07.

From the foregoing it appears that the average age on entrance is eighteen years and eleven months.

In this connection are presented the ages, at graduation, of the class which left us in June. The two hundred eight members of the class were distributed among the different periods of life as follows:—

Under 20½	3
Between 20½ and 21	7
" 21 " 21½	14
" 21½ " 22	26
" 22 " 23	63
" 23 " 24	51
" 24 " 25	21
" 25 " 26	7
26 and over	16
Total	208*

The average age was 23 years.

STATISTICS OF GRADUATION.

Table to show the number of years spent at the Institute by students graduated with the class of 1907.

Total number of degrees of Bachelor of Science awarded June, 1907, 208.

Number receiving degree at end of one year	2
" " " " " " two years	31
" " " " " " three "	19
" " " " " " four "	127
" " " " " " five "	26
" " " " " " six "	3
	208*
Number entering from other colleges	60

Of the college men 40 were graduates and 20 non-graduates.

STUDENTS FROM OTHER COLLEGES.

Yrs. at the Inst.	*Graduate.*	*Non-graduate.*	*Total.*
1	2	0	2
2	25	6	31
3	11	8	19
4	2	5	7
5	0	1	1
	40	20	60

RESIDENCE OF STUDENTS.

The following tables show in detail and for the school as a whole the residence of students for the current year and for the last six years.

* Including one as of the Class of 1906.

A TABLE TO SHOW THE NUMBER OF STUDENTS IN EACH YEAR, FROM 1901, COMING FROM EACH STATE OR TERRITORY.

STATES AND TERRITORIES.	1901.	1902.	1903.	1904.	1905.	1906.	1907.
North Atlantic.							
Connecticut	42	43	44	48	50	36	29
Maine	30	35	34	26	22	18	23
Massachusetts	837	935	869	889	807	764	781
New Hampshire	31	34	23	36	32	26	27
New Jersey	6	8	13	16	11	15	17
New York	79	96	104	94	71	84	82
Pennsylvania	36	44	52	56	58	55	57
Rhode Island	38	40	28	19	24	23	28
Vermont	15	12	11	5	5	4	5
Total	1,114	1,247	1,178	1,189	1,080	1,025	1,049
South Atlantic.							
Delaware	3	4	3	2	1	2	1
Dist. of Columbia	14	17	15	17	13	12	10
Florida	1	2	2	4	3	3	3
Georgia	4	6	4	6	8	4	2
Maryland	16	27	25	18	19	17	18
North Carolina	6	6	7	1	–	1	–
South Carolina	2	4	–	–	1	3	2
Virginia	5	7	7	4	7	8	9
West Virginia	1	–	–	–	1	2	3
Total	52	73	63	52	53	52	48
South Central.							
Alabama	2	1	1	1	1	2	4
Arkansas	1	1	1	–	1	–	2
Kentucky	9	11	9	8	5	5	5
Louisiana	1	2	2	5	1	2	–
Mississippi	–	–	4	4	4	5	3
Tennessee	4	3	5	2	2	3	6
Texas	7	9	11	13	16	15	16
Total	24	27	33	33	30	32	36
North Central.							
Illinois	44	49	44	43	42	37	31
Indiana	11	14	6	10	10	15	12
Iowa	8	8	6	9	13	14	16
Kansas	1	1	1	4	7	6	5
Michigan	12	10	9	9	10	7	8
Minnesota	10	10	9	11	13	14	8
Missouri	19	20	22	25	29	17	14
Nebraska	3	5	4	5	4	2	3
North Dakota	–	1	1	1	–	3	4
Ohio	27	43	37	35	34	30	26
South Dakota	2	1	3	2	–	1	3
Wisconsin	11	11	13	14	12	7	12
Total	148	173	155	168	174	153	142
Western.							
California	9	15	19	18	23	21	14
Colorado	6	10	11	16	17	12	10
Idaho	1	–	–	–	–	–	–
Montana	4	3	2	5	3	3	3
Nevada	–	–	–	–	1	1	1
New Mexico	–	1	1	2	–	–	1
Oklahoma	–	–	–	–	–	–	1
Oregon	2	4	7	8	5	2	3
Utah	7	2	3	3	2	3	3
Washington	4	3	3	2	2	5	12
Wyoming	–	1	–	–	2	5	1
Total	33	39	46	54	55	52	49

States and Territories.	1901.	1902.	1903.	1904.	1905.	1906.	1907.
Hawaii	–	–	1	1	1	2	2
Philippine Islands	–	–	–	4	2	3	1
Porto Rico	1	2	2	4	5	2	3
Total	1	2	3	9	8	7	6
Total for the United States	1,372	1,561	1,478	1,505	1,400	1,321	1,330

A Table to show the Number of Students in Each Year, from 1901, coming from Each Foreign Country.

Foreign Countries.	1901.	1902.	1903.	1904.	1905.	1906.	1907.
Argentine Republic	–	–	–	–	–	1	2
Armenia	–	–	1	1	3	2	2
Australia	–	2	3	1	3	3	3
Austria	1	–	–	–	–	–	–
Belgium	–	–	–	–	–	1	1
Bermuda	2	1	1	–	1	1	–
Brazil	4	5	3	3	1	–	2
British Columbia	–	–	–	–	–	1	–
Cape Colony	–	–	–	–	–	1	1
Central America	–	–	–	1	–	–	–
Chile	1	1	1	1	2	1	1
China	1	1	2	8	8	7	9
Costa Rica	–	–	–	–	–	–	2
Cuba	1	2	3	4	4	4	4
Denmark	1	1	1	1	1	1	1
Ecuador	–	–	–	1	–	2	2
Egypt	–	–	–	–	1	2	2
England	3	3	4	4	5	6	4
France	1	–	–	1	1	–	–
Germany	3	1	2	–	–	–	–
Honduras	–	–	–	–	–	1	–
India	–	–	1	1	2	1	1
Ireland	–	1	1	–	2	2	3
Italy	–	–	–	–	2	–	2
Jamaica	1	–	–	1	–	1	–
Japan	2	1	2	1	3	5	3
Korea	–	–	–	2	–	–	–
Malta, Island of	–	–	1	1	–	–	–
Manitoba	–	1	1	–	–	–	–
Mexico	7	10	8	4	7	12	12
New Brunswick	2	2	1	2	4	3	2
Nova Scotia	6	8	9	4	1	4	3
Ontario	3	2	2	5	6	6	4
Panama	–	–	–	–	–	–	1
Paraguay	–	–	–	–	–	–	1
Peru	–	–	–	–	1	1	2
Poland	–	–	–	–	–	–	1
Quebec	2	–	1	2	1	1	–
Russia	1	–	–	–	–	–	2
Scotland	–	1	1	2	1	1	1
Sweden	–	–	–	1	–	–	–
Syria	–	–	1	1	–	–	–
Transvaal	–	–	–	1	3	3	3
Turkey	1	4	–	2	1	1	2
Uruguay	–	–	–	–	2	1	1
Total	43	47	50	56	66	76	80
Total in school	1,415	1,608	1,528	1,561	1,466	1,397	1,410

RESIDENCE OF STUDENTS FOR THIS SCHOOL YEAR.

States.	Candidates for Advanced Degrees.	Fourth Year.	Third Year.	Second Year.	First Year.	All Regular Students.	Special Students.	Total.
Alabama	–	1	–	–	–	1	3	4
Arkansas	–	–	1	–	–	1	1	2
California	–	1	1	2	2	6	8	14
Colorado	–	1	3	2	–	6	4	10
Connecticut	–	7	8	3	6	24	5	29
Delaware	–	–	–	–	–	–	1	1
Dist. of Columbia	1	1	–	2	5	9	1	10
Florida	–	–	1	–	1	2	1	3
Georgia	–	–	1	–	–	1	1	2
Hawaii	–	–	–	–	–	–	2	2
Illinois	1	4	4	5	4	18	13	31
Indiana	3	3	2	–	1	9	3	12
Iowa	–	3	6	2	–	11	5	16
Kansas	–	2	–	–	–	2	3	5
Kentucky	–	1	1	–	2	4	1	5
Maine	–	3	3	3	6	15	8	23
Maryland	–	2	5	2	2	11	7	18
Massachusetts	7	116	98	141	191	553	228	781
Michigan	1	2	–	2	1	6	2	8
Minnesota	1	–	–	–	–	1	7	8
Mississippi	–	–	1	1	–	2	1	3
Missouri	–	4	2	–	1	7	7	14
Montana	–	1	–	–	–	1	2	3
Nebraska	–	1	–	–	–	1	2	3
Nevada	–	–	–	–	–	–	1	1
New Hampshire	–	1	3	4	3	16	11	27
New Jersey	–	4	3	1	2	10	7	17
New Mexico	–	–	–	–	–	–	1	1
New York	–	8	13	13	15	49	33	82
North Dakota	–	–	–	1	1	2	2	4
Ohio	2	4	3	4	3	16	10	26
Oklahoma	–	–	1	–	–	1	–	1
Oregon	–	–	–	–	1	1	2	3
Pennsylvania	1	11	9	8	1	30	27	57
Philippine Islands	–	1	–	–	–	1	–	1
Porto Rico	–	–	–	–	–	–	3	3
Rhode Island	–	3	7	2	7	19	9	28
South Carolina	–	–	–	–	–	–	2	2
South Dakota	–	1	–	–	–	1	2	3
Tennessee	–	–	1	–	1	2	4	6
Texas	–	4	3	2	1	10	6	16
Utah	–	–	–	–	1	1	2	3
Vermont	–	–	–	–	2	–	3	5
Virginia	–	–	2	2	1	1	6	9
Washington	–	–	–	–	2	2	4	12
West Virginia	1	1	–	–	1	3	–	3
Wisconsin	–	1	–	2	3	6	6	12
Wyoming	–	–	–	–	–	–	1	1
Foreign Countries.								
Argentine Repub.	–	–	–	–	–	–	2	2
Armenia	–	–	–	1	–	1	2	2
Australia	–	1	–	–	–	1	2	3
Belgium	–	–	–	–	–	–	1	1
Brazil	–	–	–	–	2	2	–	1
Cape Town	–	–	–	–	–	–	1	2
Chile	–	–	–	–	–	–	1	1
China	–	1	–	–	–	1	8	9
Costa Rica	–	–	–	–	1	1	1	2
Cuba	–	1	–	–	1	2	2	4
Denmark	–	1	–	–	–	1	–	1
Ecuador	–	–	–	–	1	1	1	2
Egypt	–	–	–	1	–	1	1	2
England	–	1	1	–	–	2	2	4
India	–	–	–	–	–	–	1	1
Ireland	–	–	–	–	–	–	3	3
Italy	–	1	–	–	–	1	1	2
Japan	–	1	–	–	–	1	2	3
Mexico	–	1	2	2	–	5	7	12
New Brunswick	–	–	–	–	–	–	2	2
Nova Scotia	1	–	–	1	1	3	–	3
Ontario	–	–	1	–	–	1	3	4
Panama	–	–	–	–	1	1	–	1
Paraguay	–	–	–	–	1	1	–	1
Poland	–	–	–	–	–	–	1	1
Peru	–	–	–	–	1	1	1	2
Russia	–	–	–	–	1	1	1	2
Scotland	–	1	–	–	–	1	–	1
Transvaal	–	–	–	–	–	–	3	3
Turkey	1	–	–	–	–	1	1	2
Uruguay	–	–	–	–	–	–	1	1
Total	20	208	187	211	276	902	508	1,410

RESIDENCE OF MASSACHUSETTS STUDENTS.

(1) From Counties.

County.	No. of Towns.	No. of Students.	County.	No. of Towns.	No. of Students.
Barnstable	1	5	Middlesex	29	238
Berkshire	6	15	Nantucket	1	2
Bristol	8	28	Norfolk	18	95
Dukes	2	3	Plymouth	15	28
Essex	23	105	Suffolk	4	218
Franklin	3	4	Worcester	12	18
Hampden	3	18	Total	128	781
Hampshire	3	4			

(2) From Cities which send Five or More Students.

Boston	201	Springfield	12	Arlington	5
Newton	46	Hyde Park	11	Barnstable	5
Brookline	39	Salem	10	Beverly	5
Cambridge	28	Quincy	8	Gloucester	5
Somerville	28	Winchester	8	Marlboro	5
Lowell	18	Framingham	7	Medford	5
Malden	17	Revere	7	Natick	5
Lawrence	15	Wellesley	7	Reading	5
Taunton	15	Chelsea	6	Stoneham	5
Lynn	14	North Adams	6	Weymouth	5
Waltham	13	Wakefield	6		
Newburyport	12	Abington	5		

SUMMER SCHOOL.

Table showing the Number of Students registered in Each of the Courses of the Summer School for this Year and the Year before.

	1906	1907
Air, Water and Food Analysis	4	0
Analytic Geometry	20	29
Applied Mechanics	19	19
Carpentry and Wood Turning	4	12
Chemistry, Inorganic and Analytical	39	47
Chipping and Filing	9	8
Descriptive Geometry	35	37
Design	9	18
Forging	16	16
French	9	14
German	10	16
Integral Calculus	14	6
Machine-Tool Work	27	27
Mechanical Drawing	21	14
Mechanical Engineering Drawing	19	20
Mechanism	18	13
Metal Turning	1	1
Organic Chemical Laboratory	0	11
Pattern Work	3	14
Physical Laboratory	10	9
Physics	39	30
Precision of Measurements	6	4
Shades and Shadows	1	4
Surveying	14	35

ADDITIONAL STATISTICS.

	1906	1907
Number from other colleges and schools attending	39	58
Number not referring to any other college or school	4	1
Number from Massachusetts Institute of Technology	186	224
	229	283
Number who registered, but did not attend	14	10
Number who applied, but cancelled registration	2	3
Registrations for failures or deficiencies	166	347
Registrations to anticipate work	220	186

STATISTICS OF ADMISSION.

Of the 1,410 students of the present year, in regular attendance, 527 were not connected with the school in 1906–07. Of these 252 were admitted as regular students of the first year upon the basis of their entrance examinations. The 275 remaining comprise (1) those who had previously been connected with the Institute, and have resumed their places in the school; (2) those who were admitted provisionally without examinations; (3) those who were admitted by examination as regular second-year or as special students; (4) those who were admitted on the presentation of diplomas or certificates from other institutions of college grade. In addition to the 252 who were thus admitted to the first year on examination, and have taken their place in the school, 62 were admitted on examination, but have not entered the school.

In the case of the 277 persons who were admitted on examination, and have joined the school as regular students or as special students, the results of the examinations, embracing both those of June and those of September, were as follows:—

	Regulars.	*Specials.*
Admitted clear	146	2
" on one condition	60	7
" on two conditions	30	6
" on three conditions	15	7
" on four conditions	1	3
	252	25

Of the 722 persons who presented themselves in June for examination, 28 Complete, 23 Final, 68 Preliminary, and 16 Partial candidates, a total of 135, were rejected. In September 14 Complete, 13 Final, and 11 Preliminary candidates were rejected. 293 candidates, including those for advanced standing, attended the September examinations.

96 college entrance examination board certificates were submitted.

WALTER HUMPHREYS,
Registrar.

Reports of Departments.

DEPARTMENT OF CIVIL AND SANITARY ENGINEERING.

The staff of instruction has suffered a great loss the past year by the resignation of Professor Frank P. McKibben, who resigned to accept the position of Head of the Department of Civil Engineering at Lehigh University. Professor McKibben had a long and honorable service with the Institute. He was graduated in the Class of 1894, and has been continuously in the service of the Institute since that time, rising from the grade of assistant to that of associate professor. Professor McKibben devoted his summers largely to practical work, and cultivated to a high degree, that combination of the theoretical and practical which made him so valuable a member of the staff. He left us to the great regret of all his colleagues in the Department and in the Faculty, and with our best wishes for his continued success in the higher position to which he has been called.

Professsor McKibben's position has been filled by the appointment as assistant professor of Mr. L. E. Moore. Professor Moore graduated from the Department of Mechanical Engineering of the University of Wisconsin in the Class of 1900, and studied Structural Engineering at the Institute with the Class of 1902. He has had considerable practical experience, having been employed by the Illinois Central Railroad in its bridge department and in the abolition of grade crossings, by the Phœnix Bridge Company, and other concerns; he has also had experience in teaching in the University of Wisconsin and the University of Illinois and is well qualified to take up the work heretofore carried on by Professor McKibben.

The Department has also been strengthened by the promotion of Mr. R. D. Bradbury to be Instructor in Civil Engineering. Mr. Bradbury is a graduate of the Institute in the Class of 1906, having come here from the University of Missouri. He has devoted most of his spare time to gaining practical experience, and during the past summer has been employed by Mr. S. E. Thompson on expert work connected with reinforced concrete construction.

Messrs. G. L. Hosmer, C. B. Breed, and George E. Russell have been promoted from the grade of instructor to be assistant professors in Civil Engineering. Professor Breed devotes himself to the instruction in Railroad Engineering, Professor Hosmer to that in Topographical Engineering, Geodesy and Astronomy, and Professor Russell to that in Hydraulics, Stereotomy and Structures.

A new staff of assistants was engaged from the Class of 1907, and on the whole the staff of the Department is as large and fully as efficient as it has ever been.

During the past summer Professors Mott and Russell have been engaged in the work of investigating the traffic conditions in the city of Boston for the Boston Transit Commission, in accordance with an act of the legislature requiring an investigation of this character. Professor Mott also delivered a summer course of lectures on Hydraulics at Columbia University during July and August.

Professor Hosmer devoted the summer to practical work in the employ of Mr. W. S. Johnson, Consulting Engineer, of the Class of 1889.

Professor Breed has been engaged as an expert for the city in the case of the abolition of grade crossings at Lynn, in connection with which work he has made plans and given testimony relating to the case.

Professor Moore spent the past summer in the employ of the Illinois Central Railroad on the abolition of grade crossings in Chicago.

Mr. J. W. Howard occupied the summer in the employ of

the Harbor and Land Commission, in surveying work of various kinds.

The class graduating in Civil and Sanitary Engineering in June, 1907, numbered 38, which is the largest number ever graduated from the Institute, with the exception of the year 1906.

There has been, as usual, a large demand for men, and almost all of the graduates are occupied in engineering work, while positions were offered sufficient for a much larger number. This demand for men continued until late into the summer, 145 positions having been offered between March and September. At the present time, owing to the recession in business, a readjustment is taking place and some of our graduates are temporarily losing their positions. The past few years, indeed, have been rather demoralizing for young men entering any of the engineering professions, on account of the fact that the demand for men has been so great that even poor men have had no difficulty in securing positions at high salaries. A readjustment of these conditions will not be without advantage, as it will make more room for the best men, and will enable them in the future to advance even more rapidly, while the poor men will feel an added spur to "make good."

APPLICATIONS FOR MEN, APRIL TO AUGUST, INCLUSIVE.

	1903	1904	1905	1906	1907
Railroad	39	9	47	27	19
Structural	19	7	16	43	22
Teaching	7	7	7	22	42
Hydraulics	3	9	33	16	9
Civil Service Examinations	—	—	—	31	12
Miscellaneous	24	15	32	24	41
Totals	92	47	135	163	145

Additional evidence of the success of our graduates in passing competitive examinations comes to attention from time to time. In a recent examination for an important position the man who stood first was an Institute man, the men who stood second and third were Cornell men, and the man who stood fourth was an Institute man. The latter now occupies the position, the

others having declined. One of our graduates also passed a competitive examination for civil engineer in the Navy, with high rank, and has been appointed to this important position. No change has been made in the curriculum since the date of my last report, but the change therein mentioned, due to the cutting out of one year of Modern Language, now becomes operative in the third year, and will enable an improvement to be made in some branches of our professional instruction. No attempt, however, will be made to cover a wider field than has been covered in the past. The additional time which has been gained will be utilized in giving more time to emphasizing fundamental principles, and not in covering additional ground.

No change has been made in the conduct of the field work in Surveying, to which I referred in my past report. If funds can be provided, I believe it would be desirable to concentrate this field work in the summer, and I would respectfully call the attention of the Corporation to the considerations which were brought forward in my last report in connection with this matter.

The Department is crowded for space,—a fact to which I have referred in previous reports. We now have as many students as we can handle to advantage in the rooms which are at our disposal. The library, moreover, is very crowded, with scarcely any room for tables. When the question of a new site for the Institute is finally decided, these matters will, of course, be adjusted, and the Department of Civil Engineering will no doubt be given an opportunity to expand, which it has not at present.

During the past year a number of interesting investigations were made by students in this Department as thesis work. Several students, with the assistance of means furnished by the Transit Commission, carried on a series of tests with reference to earth pressure; these tests will be continued during the present year, and it is hoped that additional results of interest will be obtained. Messrs. Hastings and Morrill made some tests of steel angles in tension, a continuation of work

begun in the previous year; and the results were incorporated in a paper by Professor McKibben, presented by him before the American Society for Testing Materials. Other tests were made on reinforced concrete.

GEORGE F. SWAIN.

DEPARTMENTS OF MECHANICAL ENGINEERING AND APPLIED MECHANICS.

Inasmuch as these Departments are called upon to provide a very considerable amount of instruction for the students of all the engineering Courses, the total number of students is always very large, and besides the class-room, the drawing-room, and the regular laboratory work, a large amount of investigation is carried on, partly in connection with the regular laboratory work, but mainly in connection with the thesis work, not only of Course II., but also of some of the other Courses.

The result is that the resources of these Departments, and especially of the laboratories, have, for a number of years, been taxed to their utmost, as the supply of additional apparatus, and of space, has not kept up with the needs.

Notwithstanding the changes that have been made from time to time in the Course in Mechanical Engineering and the constant improvements and developments continuously effected in each of the professional subjects taught, in the endeavor to meet the needs of the modern developments in engineering practice, the latter have become so rapid that it has been found necessary by the Department to gain more time for a number of subjects; and accordingly, one year of study of Modern Language has been dropped, and the time thus gained has enabled us to increase the number of hours devoted to Literary subjects, Applied Mechanics, Steam Engineering, Power Plant Design, and Electrical subjects.

These changes in the Course take effect for the second-year class of the present school year, and constitute a very considerable improvement in the course of study.

The Corporation having made a special appropriation for the purchase of a superheater, and of a steam turbine, steps were taken to secure them, with the result that an independent superheater has been already installed, and that the steam turbine has been ordered, and is expected during the second term of the present school year. The superheater is capable of superheating ten thousand pounds of steam per hour, at two hundred and fifty pounds pressure, two hundred and fifty degrees Fahrenheit. It will enable us to use superheated steam in many of our investigations on the flow, and on the properties of steam.

The steam turbine, which has been ordered, is of five hundred kilo-watt capacity, and is fitted with a hydraulic brake instead of a generator, though it is so arranged that a generator can be added, whenever, for any reason, it may be thought desirable.

The turbine is manufactured and furnished by the Westinghouse Machine Company, who made us a very liberal donation, thus bringing the cost nearly within our means, while the difference has been kindly contributed by certain members of the Visiting Committee of the Department.

The turbine will enable us to study experimentally, and on a practical scale, many problems connected with the performance of this important motor, including questions of steam losses, leakages, etc.

Besides the superheater and the steam turbine, the following smaller apparatus has been added, viz.:—

(1°) A thirty-six-inch hydro-extractor, for the purpose of studying experimentally the laws of running balance of machinery having a high rotative speed.

(2°) A Starrett mine pump, presented to the Department by the makers.

(3°) A compressor, owned by the Mining Department, and loaned to the Mechanical Engineering Department.

(4°) An additional cement testing machine.

(5°) A Thomas calorimeter.

Though much additional apparatus is needed, the following are the most pressing needs at the present time:—

(1°) A surface condenser of a capacity of eleven thousand five hundred pounds per hour.

(2°) A refrigerating plant.

(3°) An impact testing machine.

Besides these we need a stationary plant for testing locomotives. There are several such plants in existence, and, while we frequently make investigations by means of road tests of locomotives, such a plant would enable us to increase very much our usefulness to the engineering public.

The practice of these laboratories in carrying on a considerable amount of investigation of modern engineering problems has been, as usual, continued, partly in connection with the regular laboratory work, but mainly in connection with the thesis work.

Among investigations now being carried on in connection with regular laboratory work may be mentioned:—

(*a*) Friction of air flowing in pipes, and losses due to elbows and bends. The amount of experimental data available upon this subject, at the present time, is very small.

(*b*) Investigation of the flow through orifices of steam with different amounts of moisture, under small differences of pressure.

In this connection may be mentioned, also, the following portions of the thesis work of last year:—

(*a*) The investigation of locomotive driving springs has been continued.

(*b*) The investigation upon re-enforced concrete beams has been continued.

(*c*) Investigation of the effect of water upon the fire-resisting properties of fire brick.

(*d*) Investigation of the variation in the angular velocity during one stroke of a reciprocating engine.

(*e*) There were a number of tests of Producer Gas Plants under one hundred and fifty horse power and one of five hun-

dred kilo-watt capacity. There was also a design of a producer-gas power station, including buildings, foundation, wiring, and all accessories.

(*f*) A special investigation, which is now being carried on by a candidate for an advanced degree, consists in determining the velocity and the energy of a jet of steam issuing from a flared nozzle. The apparatus to be used in this work was so designed as to make it possible to weigh directly the reaction of the jet.

Experiments are to be conducted with different boiler pressures and with nozzles of different lengths. The first nozzle experimented upon will be one of seven-eighths-inch diameter at the throat, two and fifty-seven hundreths inch diameter at the large end, and eighteen inches in length.

Besides the gifts already mentioned, the following should be noted:—

(*a*) Complete sets of blue prints of Locomotives have been presented to the Department by the Baldwin Locomotive Works and by the American Locomotive Company.

(*b*) Considerable valuable literature has been provided at our request, for the use of the students, by the following firms: the American Locomotive Company, the Baldwin Locomotive Works, the Crosby Steam Gage Company, the Carnegie Steel Company, the Draper Company, the Jones & Laughlin Steel Company, the B. F Sturtevant Company, the Walworth Manufacturing Company, and the R. D. Wood Company.

(*c*) Valuable modern apparatus has been sent to the Department for use in connection with the work in the drawing-room by the Fitchburg Machine Tool Company, the B. F. Sturtevant Company, and the Napier Motor Company of America.

While the results of investigations of modern engineering problems made in these laboratories are of very considerable value to the engineering and industrial public, such investigations are, at present, subject to the requirements of the regular laboratory work, to the limitations of time imposed upon thesis work, and to the necessary employment thereon of undergraduates, who are thus gaining the ability to investigate. It would be

very desirable, therefore, to have certain special assistants, of the grade of instructor, who should not be called upon for any work connected with giving instruction to undergraduates, to carry on prolonged investigations. It would be necessary to provide for their exclusive use a considerable amount of apparatus, so that they would not have to depend upon the employment of apparatus at such times as it could be spared from its other uses. In the case of some of the larger pieces of apparatus, however, which it would not be feasible to duplicate, the use which they could make of them would have to be subject to the requirements of the regular work of the school. Moreover, it would be necessary to make such arrangements as to enable these investigations to proceed continuously, without being interrupted by the summer vacation.

In addition to the above, it would be necessary to provide the means of preparing the results for publication, and of publishing them. Indeed such a provision would be very desirable, even under present conditions, as the duties of the assistants and instructors who are engaged in the regular work of the school do not leave them time enough for such work.

It is evident that we need a considerable amount of additional apparatus, to provide for the regular laboratory work, and also for the thesis work of our large classes, to enable us to undertake, in the laboratory, the solution of many modern engineering problems, with which we are not equipped to deal at present, and for purposes of investigation.

More room is also needed, for new apparatus, to relieve present crowding, to furnish room for students to carry on thesis work on apparatus brought in from outside, to provide storage room for large and miscellaneous apparatus to be used on thesis work conducted outside, and to provide room for stripping machines for the purposes of Machine Drawing.

GAETANO LANZA.

DEPARTMENT OF MINING ENGINEERING AND METALLURGY.

The number of students in the Mining Department is about the same as last year, the number in the fourth year having fallen off a little, and that in the second year having increased.

The demand for graduates of the Mining Department has been extraordinarily large this year, not only for young engineers to take positions in the mines and works, but for teachers and professors to teach the subjects in the mining schools of the different states. It has been impossible to supply the demand. Just now, since the hard times have come, the demand is slackening a little, and some of the men who were placed before are losing their positions.

Many students have received work for the summer at mines and mills in the West and Northeast, so that they can get a valuable insight into mining and metallurgical operations while they are still taking their course at the Institute. The effect of this is very advantageous.

The Mining Course is undergoing a general rearrangement at the present time, the object being to eliminate all inconsistencies that have crept in, and to get the time distributed to the best advantage for the student.

In the Ore-dressing Laboratory two new pulsator classifiers and a new pulsator jig have been installed. They are the property of Professor Richards, but are placed at the disposal of the students. These machines bid fair to create something of a revolution in ore-dressing works. A canvas cover has been tried on the round table with good success. This may prove a valuable innovation for the mills. There is in contemplation the purchase of a new Johnston vanner of the kind that is at present used at the Utah Copper Company's mill, which has shown remarkable perfection of work. A newly designed top for a Wilfley table has been put in, which is ex-

pected to yield better results than those previously employed. A small new Hansell hand jig has been installed. Two compressors for compressing air have been purchased and installed for general use in mining and metallurgy. An accelerated motion adopted in the Lake Superior mills for the jigs has been adapted to the use of the laboratory, and a very successful jig has resulted.

The general plan of work in the Metallurgical Laboratory has remained about the same; several important changes, however, have been made in the details. The students now receive general schemes outlining the work to be done, the observations to be made, and records to be taken; at a fixed time after a run, reports upon it have to be handed in. This new requirement has added greatly to the value of the work.

With all laboratory exercises, it has been the rule so far to take an account of stock of the metal in order to determine the yield by the process in the end products and intermediary products, and thereby the percentage of metal lost. In the blast furnace work and roaster work the ground covered by the reports has been extended to include measurements of temperatures and analyses of gases, which permits making a thermal balance of a smelting operation and determining accurately the changes of temperature necessary to obtain a satisfactory roast. The usual method of estimating temperatures by the eye is thus controlled by the use of the pyrometer. The thermo-electric pyrometer of LeChatelier has been supplemented by the optical pyrometer of Fery.

The Metallurgical Laboratory has received the necessary equipment for developing microphotographs. This makes the work independent of the dark room of other Departments. Mr. C. R. Hayward spent some time last summer in the metallographical laboratory of Columbia University, New York City, to become familiar with the methods of work in use there, and thus improve upon our own plant and mode of instruction.

Professor Richards has continued his researches in the direc-

tion of ore dressing, and is from time to time installing new apparatus for this purpose along the line of classification of ores. Some very valuable conclusions have been reached in these investigations, and the apparatus is placed at the disposal of the students, so that they can make researches also along these lines.

Professor Richards has accepted work in the Western mills for the purpose of keeping him in touch with the present state of the art of concentration of ores in the largest and best equipped mills of the country. This line of work is on the increase at the present time. Professor Locke made a long trip during the summer, studying the mines of the North and East in order to keep himself in touch with the present state of the art.

For research work there have been acquired a Friedrich gas reverberatory furnace in which the temperature is under absolute control, an Heraeus electric resistance tube furnace for temperatures up to 1400° C. in any kind of atmosphere, and a Siemens millivoltmeter. The tendency of the laboratory is to develop the research side of the work by providing apparatus which allow control of temperatures.

The Summer School of Metallurgy last summer visited the Maryland Steel Company at Sparrows Point, Md., the Pennsylvania Steel Company, and the Central Iron and Steel Company near Harrisburg, Penn., the great iron mines near Lebanon, Penn., and the new concentrating plant, coking plant, and blast furnaces at Lebanon. At this place they also visited the puddling plant of the American Iron and Steel Company and the foundry of the Lebanon Steel Casting Company. At Bethlehem they visited the works of the New Jersey Zinc Company and the Bethlehem Steel Company, and at Northampton, Penn., the Atlas Cement Works. Then they went up to Hazleton and visited an anthracite mine and breaker of the Lehigh Coal Company. Lastly from New York City they visited the Balbach Lead Smelting and Refining Company, the Nichols Copper Company, the Raritan Copper Company, and the Atha Steel Company.

The library has received a new wall-case for folio periodicals and books. Professor Richards has presented to the library sixty-five books and pamphlets, and Mr. Arthur Winslow (III. '81) has deposited a large assortment of books, periodicals, and pamphlets which have been of much use to the Department and its members.

There is to be mentioned the old problem of lack of space. The ore-treatment, which is much developed at the Institute, is cramped for room. The study of the properties of metals and alloys requires a great deal more space than is available at present, and the research division ought to have a separate laboratory which can be kept clean, a thing that it is impossible to do where ore and metals are being subjected to experimental work.

Two valuable theses have been prepared during the last year, one by Messrs. Davis and McMillin, developing a new idea in concentrating tables. Their work reflected great credit upon them, and covered the ground extremely well. The other was by Messrs. Coupal and Hampton in which they ran a blast furnace, making not only the usual account of stock metal and of all metals and values contained in the ore, but also a complete thermal balance of the heat generated by combustion and the heat absorbed in the furnace.

Professor Richard W. Lodge has just resigned his position of Assistant Professor of Mining Engineering and Metallurgy, in which capacity he has had charge of instruction in Assaying, of some of the Metallurgical Laboratory work and the general oversight of the John Cummings Laboratory of Mining Engineering and Metallurgy. As he began in October, 1888, this makes nineteen years of service he has completed. Professor Lodge's work with the students has been good, and his insistence upon positive knowledge and strict accuracy have been a valuable adjunct to the Course. He carries with him the best wishes of the Department.

Professor Edward E. Bugbee has come to us as Professor Lodge's successor. He was graduated at the Institute in the

Class of 1900, and has since held various positions. He was Assistant at the Institute for the school year 1900–01, Chemist with the Brookfield Mining Company from June to October 1901, Assistant at the Institute from October to February 1903, Special Agent for the United States Census (Mining Investigation) from February to September 1903, Assistant Professor of Mining Engineering and Metallurgy in Iowa State College from September 1903 to September 1906, Assistant Professor in Mining Engineering and Metallurgy in the University of Washington from September 1906 to March 1907, and Assistant Geologist in the United States Geological Survey from March 1907 to date. Professor Bugbee therefore brings to the Institute the fruits of his experience in the field and in other schools.

A temporary change has been made in advancing Mr. Reed to the position of Instructor in the Assaying Department. Mr. Angelo Heywood has been appointed Assistant in Ore-dressing and Mr. Grant of Dalhousie University has been appointed Assistant in the Metallurgical Laboratory.

ROBERT H. RICHARDS.

DEPARTMENT OF ARCHITECTURE.

The last year was one of peculiar interest to this Department. The fourth-year class was unusually large and of more than average ability.

The *Technology Architectural Record* was launched as a quarterly magazine, and has already proved itself well worth the labor expended upon it. It has been the means of a strong reawakened interest in the Institute among our alumni, as shown by the many letters received in approval of this effort.

The American Institute of Architects at its Fortieth Annual Convention at Washington in January of this year gave active evidence of its interest in the architectural schools through its Committee on Architectural Education. As expressed in the

Committee's report: "Through co-ordination, a unification of standards, and co-operation, we believe that in a few years the education offered in this country might be looked upon as final except for the absolutely necessary element of study and cultivation through travel and research amongst the inimitable monuments of the pagan and Christian past." The result of the acceptance of the report was a meeting held by the Committee in New York in the May following, to which were invited the heads of the architectural schools of Columbia, Cornell, Harvard, Pennsylvania, and the Institute of Technology. They all responded. The most tangible result of that meeting was to inaugurate a system of competitions between the schools, and the experiment was made to hold the first one during the summer vacation. The difficulty of control of vacation work has proved, however, that it is not practicable to carry out this plan, and at another meeting held last month it was decided instead to have the competitions a part of the school curriculum. Preparations are now being made to accomplish this. The Department is much interested in the success of the experiment.

The last year was also the first in which the Perkins Travelling Fellowship was awarded to a woman. The successful competitor was Miss Ida A. Ryan, '05. The jury was composed of Mr. R. S. Peabody, President of the Boston Society of Architects, Mr. J. Randolph Coolidge, Jr., its Chairman on Education, assisted by the staff of the Department. Three other competitors were given honorable mention. Miss Ryan sailed for Europe in October.

We have much to be grateful for in the active support of the Boston Society of Architects. In April the studio of the Department was the scene of the Society's monthly dinner and meeting, which was held there for the purpose of awarding the prizes, the gifts of the Society, won in the annual competition among the fourth-year students. Mr. Peabody presided and presented the prizes; E. F. Lewis and Winsor Soule shared the one for regular students. The prize for special students was given to A. N. Rebori. In another way the sympathy of the Boston

Society was shown when Sir Aston Webb was a visitor in Boston. The Society gave a reception to him and Lady Webb in the library and drawing-rooms of the Department, and there were no more appreciative guests on that occasion than our students. The informal address made to them by Sir Aston will always be a most interesting memory.

The two Rotch prizes of two hundred dollars each were given, according to the will of Mr. Arthur Rotch. One prize was awarded to E. F. Lewis, a graduate in the regular Course, the other to R. B. Barnes, a special student of two years' standing.

M. H. Whitehouse, the holder of the 1906 Travelling Scholarship, returned from Europe at the end of his year's study. There was held in the Department an exhibition of his work, the quality of which fully proved his ability to profit by the opportunity given him.

The usual Summer School of the Department was held during July and August with sixteen students in attendance. The Institute, we believe, is the only school offering a regular summer course in Architecture, and the gradual increase in attendance since the beginning, indicates its value to college graduates, and to specially prepared students already in the Department, in gaining a year in the regular course in design. A number of teachers of drawing in secondary and trade schools have also taken advantage of the summer courses to supplement their regular work.

As affecting our present work, I beg to present to your consideration two important matters. First, the desirability of requiring in the near future five years' attendance in this Department to attain the Bachelor's degree. Beginning fifteen years ago, the necessity of a longer school training for our students became evident and the effort of the Department was directed to that end. President Walker's entire sympathy was with such an extension, as may be seen in his reports; but conditions at that time did not seem ripe for such a change. Since then we have set forth the importance of such a movement whenever opportunity offered. Until now our experience alone

governed our desires in this matter, but now there have come pressing demands from the architectural profession for a higher standard of graduation from the schools, which, if met, makes it imperative to lengthen the Course. The quality of the work done in our graduate year stands out very conspicuously above that of the undergraduate. This is due to the uninterrupted and continuous study of purely professional work at the time when the student is exactly ripe for it. The fifth year of the regular Course should offer practically the same opportunities that the graduate year does now. Every student needs this year in which to broaden out his professional work and to get a perspective view of what he has accomplished in his close application to the tabular views of the preceding years. It is his opportunity to apply to practice the theory which occupies so much of his previous training or to round out his equipment, if he so desires, by taking other of the many courses which the Institute has to offer.

The training of our first year might well be accomplished in a preparatory school so far as concerns its direct influence on our professional work. The degree is really given for three years of professional work. Adding another year simply places the degree where it belongs, and puts us more nearly on a par with the requirements of the other professions, no one of which demands more skilful, thorough, broad training than that of Architecture. It is always from our graduate class that architects make their first demands for assistants. Much may be gained of course by raising the standard of admission, but it is the standard of graduation that tests the schools, and we wish to have set for the whole Department that standard which is now limited to graduates.

The other matter referred to is our Travelling Scholarship. In 1906 a friend of the Department who wished to remain anonymous gave the sum of twelve hundred dollars for a travelling scholarship for that year. The accumulated interest of the Perkins Fund amounted to an equal sum in 1907, and the scholarship was continued. Our resources

are now at an end. The Department begs either that the Executive Committee may see fit to make an annual allowance of twelve hundred dollars for this purpose or that the same amount be allowed from the Austin Fund. We believe that much good would accrue not only to the school, but also to the beneficiary of this scholarship if it were stipulated that at the end of his year of foreign study he should return to the Department as an instructor for some stated time, perhaps a half-year. To the school is really owed some practical recognition of the splendid opportunity given for foreign study. Such a scholarship cannot be measured in money. It counts for position, standing, reputation to its beneficiary. His services for the profession immediately have an increased value, because the scholarship represents recognition of unusual ability. It should not be felt an obligation by the beneficiary, but a favor, to be allowed the opportunity to make the Institute a practical return, and there could be no better way of doing this than to show to those who hope to have similar opportunities some day how best to profit by them.

To our students this instruction would come at the opening of the school year, just at the time when the aid of fresh young talent would be most inspiring. To the young instructor the value of such an opportunity to teach cannot be overestimated. He learns to know himself and his own capabilities. He puts his own knowledge into training. He finds unsuspected weak points in his armor, and, when found wanting, he will endeavor to elevate his own standard for any position he may occupy later.

But better than all would be the good effect on the Institute of the successful scholar returning to the Department for this short time to teach the causes of his success. Both teacher and pupil would have a higher appreciation of what the Institute stands for. They would learn that to graduate means much more than to get through and to get out; rather that it is to begin to show work which is worthy of Institute training, and which must be proven at the Institute itself. A practical

illustration such as the above would carry weight when simple theoretical consideration would amount to nothing.

The income of the Perkins Fund amounts every four years to one thousand dollars, and is then available for a travelling fellowship, but the Department has no other scholarship endowment. It shares with the other Departments from the funds that have been left so generously for the common good, and in addition to this the Institute does all that its means permit. Cornell, Columbia, Harvard, Pennsylvania, St. Louis, have each one or two scholarships, and the Institute, the oldest of them all, should not be less favored.

FRANCIS W. CHANDLER.

DEPARTMENT OF CHEMISTRY AND CHEMICAL ENGINEERING.

The work of the year has again been characterized by progress in the development of plans previously conceived rather than by the introduction of pronounced changes. The revised Courses in Chemistry and Chemical Engineering are now in full operation, and the real test of their efficiency will begin with the post-graduate activities of the class of 1908. There seems at present to be good reason to hope that the verdict of the coming years will be favorable.

In one respect, however, the past year has been remarkable in the history both of the Institute and of the Department, namely, in the conferring of the degree of Doctor of Philosophy upon three graduate students, Messrs. R. B. Sosman, Raymond Haskell, and M. A. Stewart, who completed their investigations in the Research Laboratory of Physical Chemistry during the year. The examinations for this degree, both oral and written, were held in May, and were conducted by members of the Faculty of this Department, and those of Physics and Mathematics, and the degrees were conferred at the graduation exercises in June. Professor Noyes, under whose direction the men had carried on their investigations, presented the

candidates as Chairman of the Faculty. This was peculiarly fitting, since the occurrence at this time of this important event in the development of the advanced work on the part of the Institute is due largely to his foresight and zeal in the establishment and administration of the Research Laboratory of Physical Chemistry. It is to be hoped that this marks only the beginning of this sort of valuable service to science on the part of this laboratory, and of other research laboratories of which mention is made below.

It was noted in the Report of last year that a beginning had been made toward a greater development of research work in Technical Chemistry, and two research assistants had been appointed, to work under the direction of Professor Walker. This work has led to results which are both interesting and important for the interpretation of the phenomena which accompany, or constitute, the corrosion of irons and steels.

It was intended at the outset to take up at once the study of the practical phases of the problem, but these investigations had progressed but a little way when it became plain that the fundamental principles underlying the phenomena of corrosion required additional study, and the research was, therefore, turned temporarily in that direction. Two phases of the subject have now been practically completed. The first constitutes, in part, the matter presented as a thesis by Mr. Colby Dill last June for the degree of Master of Science, and has to do with the influence of stress upon the corrosion of iron. It is thought that Mr. Dill's work conclusively proves that stresses which produce strains not exceeding the elastic limit of the metal (which includes the majority of cases in engineering practice) are without effect upon the potential of the metal, and do not influence corrosion. Beyond this limit a marked increase in potential was noted, but this exists only as long as the stress is applied, and under these conditions other, and at present indeterminate, influences appear to be superimposed upon those of stress. The nature of these factors is one of the questions awaiting further study.

The second portion of the work, which has been carried on by Miss Anna M. Cederholm and Mr. Leavitt N. Bent, has been devoted to an explanation of the mechanism of the reaction as a result of which corrosion of iron and steel takes place.

The result of the work of the year is a confirmation of the electrochemical theory, which assumes that corrosion is an electrochemical phenomenon depending only on the difference of potential between two points and the resistance in the circuit. In addition, it has been shown that oxygen is the most important agent in causing corrosion and that the speed of corrosion of iron in water is a linear function of the partial pressure of the oxygen in the atmosphere above the water. The investigation as a whole constitutes a definite advance in our knowledge of the nature of this phenomenon, which is of such far-reaching importance to all engineering interests, and has revealed other phenomena which give promise of additional light, if further investigated. Some of these are now under examination. It is also intended to return to the practical phases of the problem, applying the results of the work of last year; and some of these investigations are already in progress.

An investigation, by a method devised some time ago by Professor Walker, of a process for annealing sterling silver without deterioration due to oxidation, blistering, pitting, etc., has also been completed. Practically all the large silver manufacturing establishments are now operating in accordance with the principles which were made clear for the first time by this investigation.

This progress of a single year appeared to justify the continuance of this plan for technical research, and it is a source of gratification to the Department that it was found possible to make an appropriation from the Charlotte B. Richardson Fund for the employment of research assistants during the current year. Meanwhile the Department is in consultation with those who have a knowledge of the conditions and requirements in the technical field, and is making progress in the formulation of a plan, which it hopes to present soon for consideration, look-

ing toward the possible establishment of a Research Laboratory of Technical Chemistry, which should be of importance alike to the Institute and to the technical interests which it would aim to serve. It is hoped that a definite decision as to the practicability of such a laboratory may be reached during the year.

The Research Assistantship in Organic Chemistry, the funds for which were in large part provided by Mr. Arthur D. Little, as noted in the last Report, is now held by Mr. Richard G. Woodbridge, Jr., and work is in progress under the direction of Professor F. J. Moore. Professor Mulliken has continued his research work on the systematic detection and identification of the organic compounds, and he, as well as Professor Moore, has directed a number of investigations in the organic field, which were carried out by students, both graduate and undergraduate.

A second invitation was received from Messrs. Harrison Bros. and Company to nominate a second-year student to participate in their summer course in Applied Chemistry. Mr. John A. Christie, of North Adams, a student in the Chemical Course, was proposed and accepted; and he, with Mr. Howard E. Batsford, who took the first year of the course last year, spent a considerable portion of the summer in Philadelphia, and both found the experience highly profitable.

In order to lessen the disadvantages incidental to the distribution of the branches of the departmental work among the various buildings, and to promote interest in and a discussion of this work on the part of all the members of the instructing staff, a series of departmental conferences was held during the year in which the work of each of several of the larger subdivisions was described by the instructor in charge and subsequently discussed informally. These conferences were apparently productive of good results. They are to be continued during the present year, and will probably include a consideration of improvements in details of methods of instruction, and also of the relations of the departmental work both to that of

the preparatory schools and to certain of the vocations for which the courses are intended to prepare the student. In the latter connection, the Department was fortunate in arranging for a short series of talks by Mr. M. C. Whitaker, General Superintendent of the Welsbach Light Company's factories, which were open to all Institute students, and proved to be helpful and valuable. Mr. Whitaker and Messrs. Charles W. Hubbard, Henry Howard, and Spaulding Bartlett also rendered helpful service by informal talks to the senior students in the Courses in Chemistry and Chemical Engineering near the close of the year. It is intended to continue, as opportunity may offer, thus to enlist the services of friends of the Department to bring directly before our students certain phases of the post-graduate professional experiences upon which they are entering, which can be best presented by those who are in the midst of these activities. It is also gratifying to note an increased interest and participation, on the part of the members of the Department, in technical affairs, and in the scientific societies of the country, which can hardly fail to result in a broader outlook and improved instruction.

The changes in the personnel of the instructing staff of the Department have been numerous, but are confined to the junior members. In all, ten instructors and assistants resigned, of whom seven were Institute graduates. Of the thirteen new assistants and instructors, nine are Institute graduates, of whom one has just taken his doctor's degree in Germany, the others being graduates of Harvard University, the University of Toronto, the University of Minnesota, and Clark College, respectively.

During the year the Department has added materially to its equipment of apparatus which has been officially standardized at the National Bureau of Standards, or the German Reichsanstalt, and is now well provided with standard sets of weights, measuring apparatus, and thermometers. The stock of platinum has been increased, and it is now possible to diminish what has often been a burden to the student, the outlay for

platinum utensils. These can now be loaned under conditions which secure a proper return for the capital invested. Dr. Gill has also introduced a card system of student and stock accounts which greatly lessens the expenditure of time and labor, particularly in the crowded period at the close of the terms. Steps have also been taken looking to the completion of certain valuable sets of periodicals in the Chemical Library, as opportunities for purchase may offer, and the library has been safeguarded by fire-proofing the partition between it and the adjoining laboratory. The material for this work was contributed by a friend of the Institute.

The Department is again confronted with a serious problem in connection with its available laboratory space. The increase in the number of students taking courses in Analytical Chemistry and in Organic Chemistry, as a result of the changes in the Courses in Mining Engineering and Chemical Engineering, has already caused serious inconvenience to the work in Organic Chemistry, and in order to make provisions for instruction of a still larger number next year it seems inevitable that overcrowding of another branch of the Department must result. In addition to these emergency requirements, there still remains the earnest desire for a reunited Department, for increased accommodations for instructors, for enlarged special laboratories, and for more small laboratories, which has often been expressed, and which finds its source in the conviction of all concerned that, when it is possible to provide these facilities, the efficiency of our work will be notably increased.

H. P. TALBOT.

THE RESEARCH LABORATORY OF PHYSICAL CHEMISTRY.

Investigations are now being carried on in this laboratory by sixteen men, of whom ten are devoting their whole time to research work. A number of these men are candidates this year for the degree of Doctor of Philosophy. This degree was

conferred last June on three of the research workers in the laboratory, Messrs. Raymond Haskell, Robert B. Sosman, and Morris A. Stewart.

Last May the laboratory suffered a painful loss in the sudden death of one of its research associates, Mr. Guy W. Eastman, a man of high character and promise.

Several members of last year's research staff have accepted technical or academic positions elsewhere. Their places have been filled by the appointment to the research staff of Professor Carl L. von Ende (Ph.D., Göttingen), Mr. John Johnston (B.Sc., St. Andrews), and Mr. Roger D. Gale, (S.B., M. I. T.). Mr. Robert B. Arnold (S.B., Rose Polytechnic) enters as a candidate for the degree of Doctor of Philosophy.

Dr. Gilbert N. Lewis, who has recently been appointed Assistant Professor of Physico-Chemical Research, is acting as director of the Research Laboratory for such time as Professor Arthur A. Noyes devotes himself to the duties of the presidency of the Institute.

This year, in addition to the seminar for research reports, the members of the laboratory meet weekly under the direction of Professors Noyes and Lewis to discuss the progress of the various investigations in the laboratory and the immediate problems to which they give rise. Two other seminars are also conducted, one by Dr. William C. Bray on Applications of Physical Chemistry to Inorganic Chemistry, and one by Professor Lewis on Free Energy and Chemical Equilibrium. These seminars are attended not only by members of the Research Laboratory, but also by many instructors and advanced students from other Departments and by several advanced students of Harvard University. The course in glass blowing is again offered by Mr. Charles A. Kraus, and the opportunity of acquiring proficiency in this useful art is being taken by a large number of men from several Departments of the Institute.

During the past year a gift of $500 has been received from the William E. Hale Research Fund. In addition, Professor

Noyes has received a grant of $2,000 from the Carnegie Institution for assistance in prosecuting the researches on the conductivity of aqueous solutions at high temperatures.

The results of the numerous investigations in this field which have already been completed in this laboratory have recently appeared in a comprehensive memoir, published by the Carnegie Institution. The work is being continued in several new directions. A new form of conductivity bomb, capable of withstanding very high pressures, has recently been constructed. In this bomb the vapor-pressures, density, and compressibility of water up to the critical point are being studied, as well as the influence of pressure upon the electrical conductivity of solutions. Closely allied investigations are being made upon electrical transference in mixed salt solutions, the solubility of salts in water at high temperatures, and the dielectric constant of water up to its critical point.

In another field of investigation which is receiving special attention in this laboratory several investigations are under way. These are directed towards the determination of the common electrode potentials, and of the free energy of important chemical reactions. Through experiments carried on during the past year Professor Lewis has succeeded in determining with precision the potential of the hydrogen electrode and its dependence upon pressure and temperature and upon the concentration of hydrogen ion. Mr. Ledyard Sargent measured by a new method the potentials between a number of common solutions, thus removing one of the chief obstacles to the exact determination of electrode potentials.

Professor Goodwin and Dr. Herbert T. Kalmus have finished an extensive investigation of the latent heat of fusion of salts, and the electrical conductivity, viscosity, and density of fused salts. They are now commencing an equally fundamental research upon the specific heats of gases at very high temperatures.

The general scheme of Qualitative Analysis, developed by Professor Noyes and Dr. Bray, is nearly completed in as far as

it concerns the common metals, and is now being extended to include the acid radicals.

Other investigations are being brought to a successful conclusion. Mr. Kraus is publishing a series of articles comprising the results of his highly original researches upon the solutions of metals in liquid ammonia. The powerful centrifugal machine for the study of electromotive forces generated in a rotating electrolyte, and the calorimeter for determining the heats of reaction at 100°, are now completed and in operation. Both pieces of apparatus were constructed with the aid of grants from the research funds of the American Academy of Arts and Sciences.

At the request of the New England Association of Chemistry Teachers a course of lectures has been established under the Lowell Teachers School of Science on the principles of Physical Chemistry and their application in the teaching of elementary Chemistry. The lectures are being given in this laboratory by Professor Lewis, and are attended by about sixty science teachers. It is hoped that the course will serve to demonstrate, in this field also, the very practical nature of the modern ideas which are comprised in the science of Physical Chemistry.

GILBERT N. LEWIS.

DEPARTMENT OF ELECTRICAL ENGINEERING.

The Electrical Engineering Course of the Institute was the first formal course of electrical engineering study established in the country. The only other course in Electrical Engineering which rivals it in age, the one maintained at Cornell University, was established, it appears, a few months later than the course at the Institute. The first students graduating from each of these two courses were in the class of 1885. In each instance the Electrical Engineering Course was the offspring of the Physics Department and remained so for some years, with the Professor of Physics in charge of the work in Electrical Engi-

neering; and the Institute is indebted to Professor Cross for the high reputation which was promptly created for the electrical engineering instruction here afforded.

The Course in Electrical Engineering was separated from the Physics Department a number of years ago. Dr. Louis Duncan was then appointed Professor of Electrical Engineering in charge of the Department of Electrical Engineering. After his resignation Professor Clifford was given acting charge of the Department. My appointment to the position of Professor of Electrical Engineering in charge of the Department was made in the late summer of 1906, but it was provided at that time that I should not enter upon the duties of the position at the Institute before the opening of the second term. Professor Clifford kindly consented to continue his relations in charge of the Department through the first term of the Institute year then about to open.

The past Institute year signalizes the inception of some important modifications in the Electrical Engineering Course. Certain changes made in the Civil Engineering and the Mechanical Engineering Courses, especially the shifting of Applied Mechanics to an earlier place in the Courses, opened the opportunity to modify similarly the Electrical Engineering Course. The modifications were presented to the Faculty by the Department, and they have now been in large measure adopted to go into effect with second-year students during the present year. A brief statement of the proposed modifications was published in the *Technology Review* for July, 1907.

In considering the plan of these modifications, resort was made to the valuable advice of the visiting committee of the Corporation and the special advisory committee of the Department. The latter committee consists of Professor Elihu Thomson, Mr. Charles L. Edgar, Mr. Louis A. Ferguson (M. I. T., '88), Mr. Hammond V. Hayes, and Mr. Charles F. Scott, all distinguished and widely known electrical engineers or executives. This committee had been appointed by the Corporation in the academic year 1905–06 at the suggestion of Professor

Clifford. It was intended that the committee should serve as an advisory committee for the Department, and I have found that the members of the committee take great interest in the educational problems of the Department. I have therefore not hesitated to call upon them for counsel and advice.

The teaching staff of the Department seems to me to be reasonably well balanced, except that it is desirable to adjust the relations of the younger members of the laboratory staff so that there will be less change in the personnel at the end of each year. I think that this can be accomplished. As the advantages of the modifications in the Course become effective, I believe that the teaching will become even more effective than heretofore. Each member of the Department who holds faculty rank has an important and absorbing field of effort which he is making his own. At the same time, measures are being put into effect to keep the instructors and assistants in touch with the more experienced teachers. The criticism that is likely to be made of the arrangement of the teaching force resides in the fact that there are relatively too many assistants in proportion to the number of men of the immediately higher ranks.

Certain changes in the teaching force followed in the train of the resignation of Professor W. L. Puffer from the position of Associate Professor of Electrical Engineering, which took place in the summer of 1906 shortly before the opening of the Institute year. Professor George C. Shaad of the University of Wisconsin was appointed to fill the vacancy and to take up most of the teaching theretofore carried on by Professor Puffer. Professor Ralph R. Lawrence at the same time took undivided charge of the Electrical Engineering Laboratory. Professor Shaad was given the title of Assistant Professor of Electrical Engineering at the time of his appointment, and he has since been advanced to the grade of Associate Professor of Electrical Engineering.

My part in the teaching at my former location (the University of Wisconsin) has of late years related mostly to the phenomena of alternating currents and alternating current ma-

chinery; but Professor Clifford's lectures prove that he has the teaching of this branch well in hand, and I have therefore here turned my attention toward lectures, recitations, and quizzes for the fourth-year men in subjects relating more directly to the executive and administrative aspects of engineering affairs. Opportunity for this work is afforded in the new arrangement of the curriculum of the Course, and the Faculty have granted to me a privilege of substitution which I can utilize until the modified Course comes into effect.

Promotions and appointments were made in the Department during the course of the year as follows:—

Professor Ralph R. Lawrence and Professor Harrison W. Smith have been promoted from the position of Assistant Professor of Electrical Engineering to the position of Associate Professor of Electrical Engineering; Mr. H. G. Crane and Mr. W. V. Lyon have been promoted from the position of Assistant to the position of Instructor; Mr. C. W. Green (University of Wisconsin, '07), Mr. A. E. Harrold (Pennsylvania State College, '07), Mr. R. G. Hudson (M. I. T., '07), Mr. C. C. Knipmeyer (University of Michigan, '07), and Mr. G. B. Thomas (Ohio State University, '07) have been appointed to the positions of Assistant in Electrical Engineering.

The Department staff and equipment continue to hold an important part in the useful work of the Lowell Institute School for Industrial Foremen.

The life of the teaching of electrical engineering subjects to undergraduates is rooted in the laboratory and the way in which the laboratory instruction is administered. It is therefore a particular satisfaction to commend to your attention the admirable way in which the standardizing and electrical testing laboratory and the electrical engineering laboratory are operated respectively by Professor Laws and Professor Lawrence.

Both of the laboratories are in most respects well equipped for undergraduate instruction, but each needs additional apparatus to make practicable the assignment of more students to each working section. This is needed for the purpose of

more satisfactorily providing for the electrical work of the students in the Courses in Civil, Mechanical, and Mining Engineering, and also for the purpose of relieving the "tabular view." But the crying defect in the Department equipment is the absence of an adequate storage battery from which perfectly steady currents may be drawn. I have heretofore furnished to you (at the request of the Chairman of the Visiting Committee) an estimate of the cost of an adequate storage battery, and I earnestly hope that money may soon be found for the purchase and installation of the battery, as I believe it would add a great deal to the effectiveness of the laboratories.

Special apparatus is also needed in the equipment, such as an electrostatic voltmeter reading to reasonably high potentials, apparatus for magnetic measurements, additional tools for the mechanician's shop, etc. An enlargement of the annual appropriation made to the Department, so that it will care for items of this character, is highly desirable.

Each of these laboratories needs more space. The Standardizing Laboratory is in very cramped quarters, and it seems to me that it could profitably occupy as much as twice its present allotment of space.

The Electrical Engineering Laboratory is a joint occupant in a main room of impressive size and shape, but a considerable part of the space in this room is occupied by the Institute electric power plant, and the laboratory is in possession of no more space than it needs in this room. There is a crying need for several additional smaller rooms for use in connection with the work of this laboratory, where apparatus may be set up for those extended tests which relate to many of the fourth-year theses and which are essential to the more substantial work of research carried on by advanced students.

The Department is also in need of one or more additional class-rooms assigned to its particular work. This large Department has only one class-room assigned solely to its own work,—all of its other class-rooms being subject to more or less constant use by other Departments, the assignments to which use

are entirely outside of the control of the Electrical Engineering Department. This condition interferes with the arrangement of suitable conferences and informal quizzes in connection with the laboratory work and lectures. The Department also needs a room assigned to use as a seminar room. This would be useful for advanced classes which often cannot be arranged to meet at inflexible hours arranged beforehand in a "tabular view," and it would also serve a good purpose as a room for holding informal weekly conferences of the teaching staff.

It is also to be earnestly hoped that the Department may soon be put in quarters where the professors can have more commodious and well ventilated and lighted offices, in order that consultations with students and others can be carried on under congenial conditions.

The instruction of advanced students may be profitably extended and developed in the Department. A demand exists in the circles of the electrical industries for young men with a wider vision and a keener analytical training than can be achieved in the undergraduate classes, and the abler men of each graduating class could wisely extend their study in the engineering school so as to embrace one, or even two, and in exceptional cases three, years of graduate study. This should be study in which the student is thrown more distinctly on his own responsibility and resources (stimulated by appropriate lectures and conferences) than is possible with the students in the larger undergraduate classes. It should include such an extent of broad, deep, and thorough study of some one subject, accompanied by a reasonable degree of independent research, as the number of years allotted to the work will allow; and this should be accompanied by the pursuit of one or two collateral branches with less intensiveness.

I believe our Department of Electrical Engineering is capable of carrying on this advanced instruction with marked success, and that doing this will be profitable to many able students who may pursue the work. It is also generally recognized that well-executed advanced instruction carried on in a depart-

ment reflects fire and enthusiasm upon the undergraduate students who are following the courses of the department.

Professor Clifford is now offering advanced lectures on the phenomena pertaining to alternating currents and high electrical potentials, and Professor Shaad is giving some advanced instruction relating to the design and operation of electric plants, besides the opportunities which exist for advanced work and research in the laboratories. This work can be extended with advantage to the students of the Department, and attention will be given to its development with full consideration of the best interests of the undergraduate work.

In connection with the development of advanced work of a character which will carry our students of established purpose and highest ambitions to a wider vision and keener training, it is desirable as occasion warrants to gather together an ideal equipment and library for research in all the branches of the wide field of Electrical Engineering. I referred to this last February in connection with the annual estimates for the Department, and shall have occasion to refer to it again. I will here point out that the electrical engineering library particularly needs more liberal support than has been possible to afford it from the annual department appropriations.

Finally, I wish to call your attention to the question of rank and pay. Men who hold the rank of Assistant Professor or Associate Professor in Electrical Engineering may be reasonably thought of as picked men of high ideals, possessing fine training and experience as men and engineers, whose ability and industry bid fair ultimately to lead them to more important distinctions and positions. Such men are not over-plentiful in engineering life, and when they are connected with industrial affairs they are likely to command unusual consideration and generous salaries, because they are capable of successfully supporting unusual responsibilities.

In considering the question of college salaries it is not commonly remembered that the men who hold the rank of assistant or associate professor in an engineering department bear re-

sponsibilities of a different kind, but which are certainly no less exacting when they are fully and properly executed, than those borne by the men of comparable age who are actively engaged in the industries. The men in academic life possess many compensations for the advantages which may be sought in engineering practice or the executive positions of industrial life, but the responsibilities required of them are heavy and the cost and effort requisite to maintaining an adequate knowledge of the progress of engineering in their respective branches are large. It seems to me that these are matters that could properly receive careful attention when fixing the rate of salaries of assistant professors and associate professor in the Department.

The Department has been the recipient of a number of gifts during the year. The following corporations contributed gifts: the American Telephone and Telegraph Company, the General Electric Company, the Holtzer-Cabot Electric Company, the Kellogg Switchboard and Supply Company, and the Western Electric Company. The important gift of a Sullivan Universal Shunt Box for use in insulation testing was made by Mr. Henry A. Morss (Course VI., class of '93).

DUGALD C. JACKSON.

DEPARTMENT OF BIOLOGY.

With the increase of knowledge, the changing needs of the times, and the development of the Institute as an educational organism, constant care is required to keep the curriculum of any Department as perfectly adapted as possible to the work which it has to do. In one of the youngest, most plastic, and most rapidly growing sciences, such as Biology, changes must be especially frequent, both to keep abreast with the times and to secure the most effective articulation of its work with that of other Departments. No changes of importance have recently been made in the curriculum of the first two years; but in the third and fourth, which had become unde-

sirably crowded with subjects, a choice must henceforward be made between professional studies in pure Biology or in applied, although, whichever line of work is chosen, some attention must still be paid to the other. In the third year these optional studies cover only six hours a week, but in the fourth year they amount to twelve hours. The choice allowed in the third year lies between Comparative Anatomy of Invertebrates and Surveying and Plotting. The former, while nearly indispensable for the student of pure Biology, is of comparatively little service to the sanitary or industrial biologist, for whom surveying and plotting is a general study of great value in those portions of his professional work where he must co-operate with sanitary engineers, landscape architects, and public health officials. In the fourth year the student will henceforward be expected to make a definite choice between studies in pure or applied Biology and to keep close to the line of his choice. In pure Biology he must pursue chiefly Zoölogy and Physiology; in applied Biology, sanitary or industrial branches. Through the former he should become fitted for investigation or teaching, through the latter for sanitary or industrial research and for participation in practical affairs connected with projects of sanitation, municipal sanitary establishments (such as purification plants for water or sewage), public health laboratories, the fermentation or food-preserving industries, etc. There is reason to believe that no institution in the United States now offers facilities superior to ours for training in these branches of applied Biology. Moreover, the maintenance of such courses and facilities supplements and strengthens the work of the Institute in Sanitary Engineering and Sanitary Chemistry. In both of these lines its leadership has long been acknowledged, and it was fortunate that when Bacteriology arose and the center of sanitary interest shifted to Biology the Institute was prepared to continue that leadership.

The development and differentiation of the curriculum just described demands more and better instruction; and if graduate work is also to be added (as is proposed in the new plans for

graduate students), more teachers, more room, and more apparatus will be required immediately. Without these the new work cannot be done. Even now, new apparatus estimated to cost $500 is needed for the best work in Microscopy; for that in Industrial Biology and Bacteriology a special room for experiments on a large scale is urgently required· larger annual appropriations for books and supplies are wanted in every sub-department; and one or two regular assistants for the elementary classes are a necessity. Most of the members of our staff are underpaid and have to add to their incomes in various ways in order to live in any comfort. The time has now come when a separate building ought to be provided for the various branches of our work. A Biology building, giving abundant light and air, and including appliances for research and instruction in Microscopy, General Biology, Zoölogy, Physiology, Bacteriology, Sanitary Science, Industrial Biology and Public Health Problems such as the Hygiene of Heating and Ventilation, School Sanitation, Industrial Hygiene, Factory Sanitation and other subjects; in other words, a building devoted to the investigation and the application of those sciences which deal directly with living matter and living things, would form a fitting component of a group of buildings for a school of pure and applied science, and would stand for that better conduct of life, that scientific humanism, which is and always must be the goal of scientific and technical education. For such a building and its equipment the sum of $100,000 would probably suffice, and I recommend that as soon as possible that sum be appropriated for the purpose.

The teaching staff of the Department has been somewhat changed during the year. Dr. Arthur W. Weysse, after several years of successful service as Instructor in Zoölogy, has withdrawn, owing to the heavy demands upon his time and strength at Boston University, where he is now Professor of Biology and in charge of the Department. Dr. Robert P. Bigelow will henceforth give instruction in Anatomy and Protozoölogy instead of in Theoretical Biology, the lectures in the

latter subject being now divided between Professor Winslow and Dr. Frederick A. Woods.

In addition to his regular duties, Professor Sedgwick has during the year made investigations of sanitary problems of public interest in Pittsburg, Penn., Jersey City, N.J., and Boston and Salem, Mass. He has also made, with the assistance of Professor Prescott, an elaborate investigation of, and report upon, the sanitary condition of the public water supply of Newport, R.I., for the Board of Health of that city.

Professor Prescott continues to act as adviser to a number of large establishments dealing in food and milk supplies or concerned in the fermentation industries, and from his close contact with these practical problems in the field brings to the technical instruction of our students in Industrial Biology and Bacteriology the latest ideas and an intimate knowledge of the processes actually employed. He still maintains a private laboratory (The Boston Bio-Chemical Laboratory) in which practical work in Economic Biology is continually going forward, and access to which forms an important educational asset for our students.

Professor Winslow has recently devoted much attention to Industrial Hygiene and Factory Sanitation, and some of the results of his experiences in that field have been immediately applied in his teaching, not only in our own classes, but through public addresses, and by a short series of lectures on Industrial Hygiene, given by invitation of the Department of Mining Engineering to students of that subject. He has also made sanitary investigations of importance in Jersey City, N.J., and Montreal, Canada. Perhaps most important, however, has been his continued service as Biologist-in-Charge of the Sanitary Research Laboratory and Sewage Experiment Station, a report upon the work of which immediately follows.

Mr. Earle B. Phelps, a graduate of the Institute from the Course in Chemistry and afterwards Assistant Chemist to the State Board of Health at the Lawrence Experiment Station and elsewhere, has from its beginning served with fidelity and

ability as Research Chemist and Bacteriologist at the Sanitary Research Laboratory and Sewage Experiment Station. In view of his good work and attainments Mr. Phelps has now been promoted to an Assistant Professorship of Research in Chemical Biology and, while most of his duties will still remain at the Albany Street laboratories, he will from time to time give instruction to our students and aid in directing their investigations.

Dr. Percy G. Stiles continues to give instruction in Physiology and Personal Hygiene, although since his promotion to an Assistant Professorship of Biology at Simmons College he is able to devote only a limited portion of his time to Institute work.

WILLIAM T. SEDGWICK.

SANITARY RESEARCH LABORATORY AND SEWAGE EXPERIMENT STATION.

In February of the present year another gift of $5,000, the fifth of like amount in annual succession, was received from the anonymous donor who has so generously contributed to the Institute thus far the entire cost of the equipment and maintenance of the Albany Street laboratories for experiment and research in sanitation, and especially the purification of sewage "by cheap and simple methods before it is cast into rivers, harbors or lakes." Work has now been continued under this annual donation for four and a half years, and during all this time the principal task set before us has been steadily kept in view, namely the possibility of purifying "by cheap and simple methods" the sewage of large cities and especially the sewage of Boston. We have gone carefully over the whole field, considering the advantages and disadvantages of the various methods hitherto known and, having decided more than two years ago that the so-called "trickling," "percolating" or "continuous" filters, first introduced into actual municipal practice in England, seemed likely to offer the best solution for a great American seaboard city, we have since that time been making

elaborate tests upon large outdoor filters of this type, running these under actual conditions of winter and of summer weather, applying to one crude sewage, and to another sewage subjected to various preliminary treatments, and to both sewage distributed and aërated in various ways. During the last summer (1907) these large experimental filters were brought to rest, carefully dissected and studied in all their parts, and then reconstructed and started again in October upon a new, and, as is hoped, final series of tests.

Our experiments, an account of which is already in press, have led to conclusions of great interest, and to a demonstration of the practicability of purifying Boston sewage by comparatively "cheap and simple" devices before it is "cast into the harbor," namely by running it continuously and rapidly through trickling or percolating filters consisting essentially of heaps of small stones, and afterwards disinfecting the stream flowing away from these filters by the addition of a solution of bleaching powder. While trickling or percolating through such heaps of small and loose stones, organic matters in the sewage capable of quick decay are converted into fixed or stable bodies which do not readily rot. By the addition of a solution of bleaching powder any disease germs present are completely destroyed. Careful estimates have been made of the area of trickling filters required to purify the present discharge at Moon Island, and it appears that an area of fifty acres would suffice,—which area might conveniently be secured by taking a portion of Thompson's Island for the purpose. The cost involved in filtration and disinfection would be for the sewage of Boston proper about $250,000 annually, and when we remember that the city of Baltimore is about to embark upon a plan of sewage disposal of this same general character and at a relatively similar expense, it is clear that these estimates, although only provisional, are probably not very wide of the mark.

Professor Charles-Edward A. Winslow, Biologist in Charge, and Professor Earle B. Phelps, Research Chemist and Bacteriologist, have continued as heretofore in direct and active con-

trol of the work of the Station. Upon the former has fallen a large part of the laborious duty of planning the details of our researches as well as that of collating and digesting researches made elsewhere, together with the formal preparation of some of our reports. Professor Winslow devoted his whole time during the summer vacation to work at the Station, and, although much of his attention and energy is necessarily given throughout the rest of the year to his classes in the Institute, he has maintained with ability and devotion his connection with the Station. In addition to bacteriological investigations upon sewage he has made, at the instigation and cost of the National Association of Master Plumbers, a new series of tests upon sewer air as a carrier of bacteria.

Special mention deserves to be made of our experiments on the disinfection of imperfectly purified effluents, such as are frequently allowed to escape from sewage purification works. These experiments were begun at the Station by Professor Phelps more than a year ago, and were briefly referred to in my last report. The first results were brought together in a paper published by him in collaboration with Mr. W. T. Carpenter, Assistant at the Station, in the *Technology Quarterly* for December, 1906. The novelty and importance of the results attracted wide attention, especially because it had suddenly become desirable to secure in Baltimore and some other places a very high degree of sewage purification in order to comply with exacting legal requirements and to protect harbors from pollution. Our work in this direction has ever since been vigorously prosecuted and with increasingly interesting and promising results. We are now regularly disinfecting the effluents of trickling filters, and have also made experiments upon the disinfection of crude sewage. In the same line, and by means of his association with the State Sewerage Commission of New Jersey, Professor Phelps was fortunate enough to be able to carry on during the last summer a special experiment on disinfection, on a large scale, at Red Bank, N.J. Here well planned tests were successfully conducted under his direction

by Mr. Francis E. Daniels, recently a graduate student of Biology and now Assistant at the Albany Street laboratories. For a period of ten weeks an average discharge of about 260,000 gallons a day from the septic sewage tanks of Red Bank was regularly and systematically disinfected. This experiment is probably the most important, as to both duration and magnitude, hitherto made anywhere. Further work along the same line is now contemplated in Baltimore, an arrangement having been made under which Professor Phelps is to co-operate in certain special experiments at the Walbrook Testing Station of the Sewerage Commission of the City of Baltimore.

Professor Phelps's connection with the U. S. Geological Survey has been continued and has resulted in a careful study of the disposal of the waste liquors of a sulphite pulp (paper) mill. This work is nearly completed and results of practical value have been reached. His connection with the State Sewerage Commission of New Jersey has already been referred to above. In addition, he has made for that Commission an extensive inspection of the various sewage disposal works of New Jersey, upon which he has submitted a report, besides recommendations as to new or improved methods required in several places. Following his advice, a plant is now being installed at Cluckamin, N.J., for experiments to be conducted under his direction upon the purification of woollen mill wastes. He has also made an investigation of a typhoid fever outbreak in the State Hospital for the Insane, tracing it to a polluted water supply. From all this work in other states there flows back to our own work a fund of experience, of criticism and of information of the highest value.

Beyond the direct results of the work coming from the Sanitary Research Laboratory and Sewage Experiment Station, indirect consequences hardly less important are constantly appearing. Around the principal sewage problems as a center arise from time to time problems of interest and importance to our Institute students of sanitation and public health. The study of these associated questions is a stimulus and encourage-

ment to our young men who, by witnessing the more advanced work of their teachers, and by themselves participating in the simpler problems, enjoy an apprenticeship no less stimulating than profitable. And while it is true that the Albany Street laboratories are at no great distance from most of the other work of the Institute, it is nevertheless certain that a closer association with the Biological, Chemical and Sanitary Engineering Departments would be in many ways of material advantage. Much of the work done on Albany Street might as easily and more serviceably be done under the same roof with other Institute work; and this fact makes it all the more desirable that a building devoted exclusively to General Biology and to be known as the Biology Building—reference to which has been made above in my report upon the Biological Department—should include all possible facilities for continued experimentation upon the purification of sewage, the purification of water, the purification of milk, and upon similar subjects bearing upon Sanitary Science and the Public Health. Such a building should in fact be designed quite as much for the subjects of Sanitary Science and Public Health as for the underlying subdivisions of Biology.

I desire again to place on record the appreciation and gratitude of all who have to do with the Sanitary Research Laboratory and Sewage Experiment Station to the donor for its continued support; and I would respectfully suggest that steps be taken by the Corporation to recognize this so large and long-continued generosity by supporting and reinforcing the work in every possible way, especially by grants of money from the Institute chest. It is also greatly to be desired that all persons interested in the work of the Station shall come forward and aid in its support. If in any way larger sums of money are supplied, much more work can be done both in wider and more far-reaching experimentation and research in Sanitary Science and in the direction of publication and other forms of education in Hygiene and Sanitation.

W. T. SEDGWICK,
Director.

DEPARTMENT OF PHYSICS.

So far as concerns the immediate wants of the Department, there is nothing new to be said. A larger lecture-room and more recitation-rooms are sorely needed. Serious difficulty has been felt both last year and this from the fact that our largest physical lecture-room has not sufficient seating capacity for the class attending the lectures in Heat given in the third year. Should there be much further increase in the number of students, which seems not unlikely to be the case, judging from the size of the present second-year class in Physics, a repetition of the lectures may be forced upon us, in the absence of any room which will accommodate as many as three hundred persons. Such a repetition of the second-year lectures has been necessary for several years past.

It would be of great advantage if the various instructors in the Department of all grades had more time for study and research than is possible with our present force.

For two years past an elementary knowledge of the principles of Physics, together with some laboratory practice, has been required as a condition for entrance to the Institute, so that in the lectures given to the second-year class of last year it was possible for the first time to take advantage of this. In view of such preliminary study of the subject as the entrance requirement implies, the lectures in General Physics have undergone a very considerable revision, which is still in progress. It is found that certain topics may safely be omitted, leaving room for a more thorough treatment of others, and, what is of more importance, it is often possible to adopt more satisfactory methods of treatment than has previously been the case. A year hence, as a result of the novel and radical changes in the course in mathematics just introduced in the first year, we shall be able to some extent to make use of the methods of the Calculus, which will be of material advantage.

While this report in strictness relates only to the work of the

school year 1906–07, nevertheless reference ought here to be made to important changes in instruction which have come into effect with the beginning of the present year.

Early last spring Mr. Clifford M. Swan, Instructor in Physics, was granted leave of absence for a year in order to pursue an advanced course of study in Harvard University.

In May last the Department sustained a serious loss through the death by accident of Mr. Guy W. Eastman, a highly valued instructor who had before him every hope of a useful and successful career in his chosen profession.

Furthermore, just at the close of the last term, after many years of devoted and successful service to the Institute in all grades of instruction from Assistant to Associate Professor, Dr. George V. Wendell resigned his position, in order to accept an appointment as Professor of Physics and Head of that Department in the Stevens Institute of Technology, an institution which from its beginning has laid the same great stress upon the necessity of a thorough and complete training in Physics as an essential factor in the instruction of an engineer that has been insisted upon at this Institute. Greatly as the loss of Professor Wendell is to be regretted, it should still be a source of congratulation that a graduate from our own Course in Physics, and one who has been thus closely identified with the work of the Department, has been chosen to fill so influential and important a position.

These changes, of which only the first-mentioned could have been foreseen, necessitated an unexpected rearrangement of the work for the coming school year, now just begun. We were fortunate in being able to secure the partial services as Instructor in Physics of Dr. Herbert T. Kalmus, a graduate in Physics from the Institute and subsequently from the University of Zürich, likewise Research Associate in Physical Chemistry at this Institute; and the whole time of Dr. Raymond Haskell, who holds the degrees of S.M. and Ph.D. from this Institute. Drs. Kalmus and Haskell together with Mr. Newell C. Page and Dr. Daniel F. Comstock, also Instructors in the

Department, divide among them the recitation-sections of second-year Physics. Assistant Professor Drisko has been given general charge of this work, which is proceeding in a very satisfactory manner. For the time being I have personally assumed the duplicate course of lectures which during the preceding four years was given by Dr. Wendell.

Much important and valuable apparatus has been procured during the year for both lecture-room and laboratory use. Additions have been made to our large collection of vacuum tubes, including a Perrin-Thomson tube showing the negative charge of the cathode rays. The apparatus for illustrating the lectures upon works, energy, and power has been largely increased in the direction of mechanical and electrical machinery.

Following the established policy of maintaining an equipment of the highest grade suitable for general laboratory instruction, the three photometer rooms of the Laboratory of General Physics have been completely re-equipped at considerable expense with the most approved form of Hartmann & Braun photometer bars, Lummer-Brodhun and Bunsen photometers, amyl-acetate and candle standards with delicate double candle balances and other accessories. Every student taking the general course is now taught the principles of modern photometric practice, as applied particularly to Gas Photometry, with the most approved form of apparatus. A modern high-grade compound microscope with complete accessories has also been added, in order to provide those engineering students who do not obtain special instruction in Microscopy with facilities for obtaining skill in this class of micrometric measurements.

It has been found practicable by some duplication of apparatus to extend the arrangement tried last year with such success, of giving the third-year laboratory course in Heat simultaneously with the lectures on that subject, so that now students in all Courses prepared to combine this work do so at the beginning of the third year. A much keener interest in the

work has resulted from this closer relation between lecture and laboratory instruction. The laboratory work in Mechanics and Optics and the related course in Precision of Measurements have been put back into the second year for the Courses in Mechanical Engineering and Naval Architecture, a change long desired by this Department, so that at present the instruction in Physical Laboratory begins in the second term of the second year and continues in close touch with the work of the class-room for all Courses except those in Mining and Chemical Engineering.

The Optical Laboratory has been supplied with a new König spectrophotometer of the horizontal type, which is especially adapted to the investigation of the absorption spectra of liquids, and is in use in connection with a research in progress under the direction of Professor Goodwin on the absorption spectra of liquid ammonia solutions of the alkali metals. A rotating-sector spectrophotometer is much needed to complete our equipment in this line. Another important addition to this laboratory is the apparatus by Zeiss for the study of microscopic objects by ultra-violet light, from the gift of the late Mrs. Katharine Bigelow Lowell, the income of which is devoted to the purchase of physical apparatus. The ultra-violet microscope will be devoted to study and research work in charge of Professor Derr. The new Lumière autochrome plates, only now procurable, will enable us to make further additions to our valuable collection of photographs in natural colors.

For the Electrical Laboratory there has been puchased, among other apparatus, a Duddell Thermo-galvanometer for the study and measurement of very minute currents, telephonic and other.

In the Laboratory of Heat Measurements a great amount of time has been devoted by Professor Norton and his assistants to the development of the calorimetric apparatus used in testing fuels for thermal efficiency. The procedure urged by United States engineers and rapidly coming into use, which proposes the specification of fuel not by name or grade, but by its calo-

rific efficiency, has emphasized more than ever the necessity for accurate and easily operated apparatus for the determination of the heat of combustion of fuel; and the energies of the laboratory have been directed toward the increase of accuracy and efficiency in such combustion apparatus. Co-operating with Professor Norton, Mr. Emerson, Instructor in Heat Measurements, has devoted a large part of the summer to reconstructing certain details of the apparatus and accumulating data, which, it is hoped, will permit of a much closer determination than has heretofore been possible by giving an accurate value of the troublesome "cooling correction." Electric furnaces, which have been developed after a series of discouraging trials, can now be used and controlled over very wide ranges of temperature and give very satisfactory results in such work as the standardizing or comparison of high temperature pyrometers. One of the recording pyrometers, ordered some time since, has been received and is in use with classes for measuring and recording the melting and critical points of steel.

Much thesis work, taken chiefly by students of Departments other than Physics, has been arranged as usual. A determination of the loss by radiation from gas engine cylinders has been begun and carried successfully through its preliminary stages. Further work in the same line is expected this year. Thesis work upon fire-proofing, a subject not developed in detail at the Institute, has been undertaken in this laboratory by a candidate for an advanced degree in Architecture; and a candidate for an advanced degree in Metallurgy has also made use of our facilities. These facts will illustrate the kind of work which the Laboratory of Heat Measurements with its equipment for the maintenance and management of high temperatures is able to carry out.

The development of a new material for use in the art of fire-proofing, a material which is a substitute for wood, and which it is hoped may have an economic value as a means of diminishing loss of life and property by fire has been ac-

complished by Professor Norton under conditions which could hardly have been realized except for the existence of the Laboratory of Heat Measurements with its complete equipment and close relations with the other laboratories of the Physical and allied Departments.

CHARLES R. CROSS.

DEPARTMENT OF GEOLOGY.

Changes of personnel in the teaching staff of the Department of Geology have been numerous in 1907. After over thirty years of successful teaching, Professor W. O. Crosby was the first professor of the Institute to accept retirement under the Carnegie Foundation. He now is enabled to give all of his time to independent research, while retaining his office in the Department. Assistant Professor Douglas W. Johnson resigned his position, owing to the demands of his work at Harvard University. Dr. Reginald A. Daly has been appointed to a newly established Professorship of Physical Geology. Professor James F. Kemp of Columbia University has accepted the position of Lecturer in Economic Geology for 1907–08, and will direct the advanced courses formerly given by Professor Crosby. Mr. de Steiguer, assistant, was obliged to go west in March, and he was succeeded for the spring months by Mr. William G. Ball (M. I. T. '05), and for 1907–08 by Mr. Charles H. Clapp of the same class.

Two students took the degree of Bachelor of Science in Course XII. in 1907. The number of enrolments in subjects given by the Department for 1906–07 was 847, an increase of 24 over 1905–06. New graduate courses of research, partly for the Master of Science degree, have been established in "Geology of the Igneous Rocks," "Advanced Field Geology," "Advanced Economic Geology," "Chemical Geology and Mineralogy" and "Advanced Paleontology."

Through the kindness of the trustees of the Caroline A. R. Whitney estate, the Department will receive a sum of money

for the purchase of a modern seismograph, wherewith to register the vibrations of earthquakes. The instrument has been ordered, and will be mounted in a suitable locality near Boston. It is hoped that this gift may mark the foundation of a Research Laboratory of Physical Geology. In the spring of 1907 thirteen thousand dollars was raised by subscription from twenty-eight individuals and corporations, to equip an expedition for the exploration of the Aleutian Islands, under the auspices of the Department. This expedition was led by Professor Jaggar, and investigations were carried on for four months. Travel was by sailing-schooner, starting from Seattle May 20th, 1907, and returning to the same port on September 11th. The economic resources, minerals, rocks, insects, plants, and physical features of the islands were studied, and collections were brought back for investigation by specialists. This expedition marks a further advance toward the foundation of a research laboratory, one of the functions of which should be exploration of volcanic and seismic lands. A fund of five thousand dollars per year for five or ten years is needed to start the work of this laboratory, and to maintain research assistants. It is hoped that eventually money will be provided to build a geophysical observatory.

On October 1st, 1907, Professor Daly assumed his duties at the Institute, having resigned his position as geologist for Canada on the International Boundary Commission. The change was made on the understanding that the completion of his report for the commision should hold first place among projects for his research work in the laboratories of this Department. This final report will summarize the results of field and laboratory work of seven consecutive years which have been spent on the geology of the western Cordillera where it is crossed by the 49th parallel of latitude. The work is being carried on for the Canadian government. To facilitate the preparation of the report, Dr. W. F. King, the Canadian Commissioner, has generously permitted the entire rock-collection made during the boundary survey to be deposited in the

Institute laboratory. The collection consists of about two thousand specimens, representing practically all the formations occurring on the 49th parallel between the Pacific and the Great Plains. Dr. King has also loaned from his government department a number of valuable instruments which will be used in the study of the rock-collection; among these is a large model Fuess petrographic microscope, provided with an unusually complete amount of accessory apparatus. As at present planned, the report will consist of a volume of text and an atlas of about thirty large plates. It is expected that its completion will occupy another year of more or less consecutive work.

During the past summer, the mineralogical and petrographical collections received many specimens, collected in part by members of the instructing staff, and in part gifts from graduates and friends of the Institute. A fine suite of specimens, illustrating the minerals and ores of Cobalt, Ontario, and Butte, Montana, is perhaps the most important of these additions. Over two tons of specimens have been received. Such gifts are encouraging to the Department, for they indicate a real interest on the part of graduates and friends and not only make unnecessary the purchase of material from dealers at an exorbitant figure, but furnish specimens better adapted for use in the practical instruction of mining students. It is to be hoped that in future the graduates and friends of the Institute will contribute even more generously than in the past. To the equipment of the mineralogical and petrographical laboratory has been added a large polarizing microscope. This instrument is especially designed for refined work in mineralogical and petrographical research and is a distinct addition to the research equipment of the Department. Eventually several special attachments will be added to this microscope.

During the vacation, Assistant Professor Warren made two collecting trips to points of interest in New York State and Nova Scotia. He was also engaged in various pieces of professional work. Two papers were completed by him during the sum-

mer: one a "Study of the Mineralogy and Petrography of Iron Mine Hill, Cumberland, R.I.," which is to appear in the January number of the *American Journal of Science;* the other a shorter paper on "Occurrence of the Rare Mineral Species, Hortonblite, at Cumberland, R.I.," to appear in the January number of the *Zeitschrift für Krystallographie und Mineralogie;* a third paper is practically completed on the "Metamorphism of the Cumberland Gabbro"; this will, however, not be published until later. The class in Mineralogy of the present year numbers approximately seventy-five men. The sections of this class for entirely successful work in a subject like Mineralogy are too large, unless two instructors are present. At the present time, the assistant can devote only a small portion of his time to Mineralogy, and it is recommended that an additional assistant or possibly an instructor be appointed in the future to co-operate in the instruction in Mineralogy. The same man would be available and very serviceable in the petrographical laboratory. Professor Warren considers it desirable to increase the available funds of the Department to such an extent as to permit of the giving of a summer school in Geology, Mineralogy, and Lithology. It is also to be hoped that some way may be found to provide a permanent fund, the income of which might be used for defraying the expenses of such students as are unable from lack of funds to attend. The advantages of summer school work of this kind cannot be too strongly emphasized. It is a matter of great importance to the economy of time during the winter semesters that such subjects as Geology, Surveying and Mining become required summer studies. If this were done in the Institute, much of the overcrowding of courses in the third and fourth year would be avoided.

Among the gifts of fossil collections received by the Department during the past year, Dr. Shimer wishes to acknowledge especially the large collection of tertiary shells from Plum Point, Maryland, given by Mr. Fred L. Franks, a former student of the Institute. Another gift by the Philadelphia Acad-

emy of Sciences consists largely of lower tertiary forms. These collections fill a gap in the index fossil series and also give material for research to graduate or fifth-year students. The book cataloguing of the fossils of the Department is almost complete and will soon be transferred to a card system for greater convenience in use. This will be an important aid to both instructors and students. A portion of the past summer Dr. Shimer spent in giving two courses in the Yale University summer school.

Dr. Loughlin has assumed charge of the courses in third-year Field-work and Building Stones and will co-operate with Professor Kemp in the advanced courses in Economic Geology. He is, this year, giving a course in General Geology at Tufts College in place of Professor J. S. Kingsley, who is on a year's leave of absence. Owing to increase of duties, he has resigned his position as compiler of foreign bibliography for Economic Geology to Mr. Charles H. Clapp.

Mr. Charles H. Clapp, assistant for the year 1907–08, comes from North Dakota, where he has been since graduation holding the positions of Assistant State Geologist and Instructor of Mining and Geology in the State University.

The Department acknowledges gratefully a gift of money from Mrs. William Barton Rogers, whereby it has been possible to bind all the unbound serial volumes in the library.

THOMAS A. JAGGAR.

DEPARTMENT OF NAVAL ARCHITECTURE.

The most notable change in the Department of Naval Architecture during the year past was a change in the course of study by which only one year of Modern Language is required; this change is parallel to those made in two of the leading Engineering Courses. Of the time thereby released somewhat more than half has been used for strengthening the technical side of the course and the remainder is applied mainly for providing options in general culture courses

The time available for technical purposes has been devoted to Mathematics, to Applied Mechanics, and to more strictly professional subjects. One great advantage obtained is the advance of Applied Mechanics to the second year, so that this fundamental subject may be kept well in advance of its application in other professional branches. It has also become possible to take up the special professional work of the Course in the second year, an arrangement which is doubly advantageous in that students come earlier to take interest in their special profession and a better foundation is laid for future work. The Department partakes in the advantages that come from increase of time and better facilities in Steam Engineering and laboratory work, which have direct bearing on a side of their profession which sometimes fails of recognition, namely Marine Engineering, for it has always been held that the best design of a ship demands a knowledge of the construction of both hull and machinery. A feature that may receive mention is the addition of the design of marine turbines; this was taken up last year and will receive additional attention this year. It is largely to facilitate this work that the text-book in Thermodynamics was rewritten, and that a chapter was added on steam turbines. Also an entirely new and important table has been computed to give rapid and accurate solution of the problems involved.

The Department has from time to time made important tests on steamships at sea, to the ends that students may become familiar with the conditions of that service and that information may be obtained that shall be useful in our instruction and to the profession. A very complete test was made in April on the steamship *Governor Cobb*, belonging to the Eastern Steamship Company, the first seagoing turbine steamer to be placed in service in America. Determinations were made of the power, speed, and economy, including the influence of the auxiliary machinery. A part of the material from the test furnished basis for theses for students of the graduating class, and a report has been presented to the Society of Naval Archi-

tects, etc. For the purpose of measuring the power a set of Denny-Johnson torsion-meters was borrowed from the Navy Department, this being the first use of that instrument in this country. Through the generosity of friends of the Department it has been possible to place an order for a set of torsion-meters of that type for the Institute, which will be set up in the Department for class instruction, and arrangements have been made with the Company mentioned to give the students experience in their use at sea.

Besides the torsion-meters just mentioned, the equipment of the Department has been enlarged by the addition of a machine for profiling ships' models and a machine for drawing frame line on models. The first greatly facilitates the cutting of models by the students, and the second is useful in laying out the plating on models.

For several years the Department has offered facilities for taking the special work of the Course in one year to graduates of other Engineering Departments of the Institute or to graduates of other technical schools having adequate preparation. This year, for the first time, advantage has been taken of this opportunity by students who come from another school, and it is to be expected that this method of using the facilities of the Institute will become better recognized in the future.

Since the institution of the Course for Naval Constructors it has been expected that the normal size of classes would be two or four, but the Navy Department has found it necessary to send larger numbers, classes of six or eight being most frequent; this year the entrance class numbers six and there are sixteen officers in the Course at the present time. The Course for that Corps has become so well systematized that for several years, it has received changes only as the growth of the Institute has made them necessary or advisable.

The following changes have occurred in the instructing staff of the Department: Mr. Charles F. Willard and Mr. John A. Ross have resigned; Mr. Harold A. Everett has been appointed Instructor in Marine Engineering, and Mr. Herman

R. Hunt Instructor in Naval Architecture; Mr. Arthur H. Jansson and Mr. Harold S. Wonson have been appointed Assistants in Naval Architecture; Messrs. Hunt and Jansson are assigned work in connection with the Course for Naval Constructors.

C. H. PEABODY.

DEPARTMENT OF MATHEMATICS.

During the past year important progress has been made in the revision of the general mathematical courses. First-year work this fall is based on the new "Course in Mathematics for Students of Engineering and Applied Science," by Professors Woods and Bailey, Volume I. dealing with Algebraic Equations, Functions of one Variable, Analytic Geometry and the elements of the Differential Calculus. The work opens with a chapter on elimination and determinants, followed by one on graphical representation. The remainder of the first term is occupied with a discussion of polynomials and their derivatives. An equal amount of time in the first term is still devoted to Plane Trigonometry.

In the second term of the first year, with a double allowance of time, the course includes as its principal subjects selected algebraic functions and their graphs, curves and their equations, differentiation of algebraic functions, change of co-ordinate axes, the general equation of the second degree, elementary transcendental functions, the parametric representation of curves, polar co-ordinates and curvature. The course as a whole aims to deal with problems of gradually increasing difficulty by the most advantageous and economical methods, irrespective of the traditional, somewhat arbitrary separation of these methods into distinct groups. By this means the student is expected to gain better judgment in the selection of mathematical methods, and better comprehension of the fundamental principles of Analytic Geometry and Calculus by reason of the longer period during which he employs them.

Professors Woods and Bailey are now engaged in the preparation of Volume II., which will, as soon as practicable, form the basis for second-year mathematical instruction.

The Department has been materially strengthened for the present year by the accession of Associate Professor Edwin B. Wilson, from the Faculty of Yale University, and of Dr. Henry B. Phillips and Dr. Nels J. Lennes, from the Universities of Cincinnati and Chicago, respectively.

The collections of the Department have been increased by the purchase of books and lantern slides adapted for use in the course in History of Science.

H. W. TYLER.

DEPARTMENT OF DRAWING AND DESCRIPTIVE GEOMETRY.

During the past year there have been two changes in the instructing staff of the Department. Mr. Samuel E. Gideon, who last year divided his time between teaching in the Drawing Department and study in the Architectural Department, has been made a regular Instructor and will give full time to the teaching of Drawing and Descriptive Geometry. Mr. John Mills has been made Instructor, giving half time to the Department and half time to study in the Department of Electrical Engineering. Mr. Mills is a graduate of the University of Chicago, Class of 1901, and was a Fellow in Physics at the same institution the following year; he was a Fellow in Physics at the University of Nebraska for the year of 1902–03, receiving the degree of A.M. from that University in 1904; since 1904 he has been Instructor in Physics at Western Reserve University, where he also developed a course in Mechanical Drawing and Descriptive Geometry.

During the summer of 1907 Professor Adams issued a second and enlarged edition of Part I. of his Descriptive Geometry; this book now covers the work taken by the first-year class. Professor Adams has in preparation Part II. of

his Descriptive Geometry, which is intended to cover the work of the second-year class in this subject.

On account of the larger number of college men entering the Institute in October, 1907, it was found necessary to divide the special class in Descriptive Geometry for college men into two sections. Mr. Bradley was asked to co-operate with Mr. Kenison in giving this instruction.

The use of good text-books facilitates the work of the teacher, but is likely to make his instruction more formal and stereotyped. To counteract such a tendency it is the intention of the Department so to arrange the course that new problems and new applications of the geometrical principles will be introduced each year. Frequent meetings of the instructors have been arranged for the coming year with a view to interesting all in the development of the course and to give opportunity for free criticism and suggestion. The personnel of the Department is now admirably adapted for such conferences, four of the instructors having had considerable experience in teaching at other colleges and schools.

ALFRED E. BURTON.

DEPARTMENT OF MECHANIC ARTS.

The total number of students receiving instruction in the Mechanical Laboratories is two hundred and eighty-six. Some attend in more than one class; the numbers attending in the several subjects are as follows:—

Carpentry and Wood Turning, II.	63
Joinery and Pattern Work, VI.	32
Forging, II., XIII.	71
Metal Turning, VI., VIII., X.	62
Chipping and Filing, II., XIII.	80
Machine-Tool Work, II., XIII.	66
Total, all classes	374
Students taking work in two or more classes and counted more than once	88
Total number of students	286

The total number of students attending last year was two hundred and forty-six. Many students have been excused from attending the Carpentry, Wood Turning and Forging classes, and a few from Pattern Work. The number of excuses granted in these earlier subjects is still on the increase, but is not yet sufficiently large to warrant giving courses in Advanced Wood Work. Such advanced work will, however, be desirable in the near future.

The attendance in the Summer School was sixty-six, an increase of ten over that of last year. The numbers attending in the several classes were:

Wood Work	15
Forging	16
Chipping and Filing	8
Machine-Tool Work	27
Total	66

The proportionally large attendance in Machine-Tool Work continues, due to the desire on the part of many students to anticipate the Mechanic Arts of the senior year, thus obtaining additional time for thesis or other departmental work.

The following new machines and apparatus have been added to the equipment of the Machine-Tool Laboratory:—

A Wright and Henry two-spindle, high-speed, upright drill; an American oil tempering furnace; a Bowser two-compartment oil cabinet. In addition the following new machines have replaced older machines of the same make: a Brown and Sharpe No. 2 universal grinding machine, a 14-inch Pratt and Whitney engine lathe and a Becker-Brainard universal milling machine. A new 14-inch engine lathe with a geared headstock has been ordered to replace one of the old 14-inch engine lathes and a new high-speed planer has been promised the Department. Some new small tools have been added to the equipment of the Wood Working Laboratory.

To maintain the required high standard in Machine-Tool Work, thirteen engine lathes, five speed lathes and a planer purchased in 1876 should be replaced at once with modern ma-

chine tools, some of which should be large and powerful enough to illustrate the use of high-speed tool steels. A small radial drill and an additional universal milling machine are needed to carry on the class work successfully.

The installation of an automatic screw machine would enable instruction in and operations of automatic machines to be given, which would be a valuable addition to our course.

Since the improvements in the Machine-Tool Laboratory were made mainly through donations and exchange of new for old machines at very liberal prices, it is hoped that funds may soon be forthcoming for modernizing the remaining old equipment.

The fixed equipment in the Forging Laboratory is now nearly worn out and can be kept in proper working condition but a few years longer. Unless its location is soon to be changed, a modern equipment should replace the present one. Six new anvils and thirty-two new tool benches are much needed.

Foundry Work is now required in Course II. and in one of the options in Course III.; the regular work of Course II. will not, however, begin until the school year 1909–10, when an entirely new laboratory should be ready. The foundry benches made in 1883 are now badly rotted, and the cupola furnace, purchased in 1876, is nearly worn out and is so small that it is exceedingly difficult to obtain good working results. The stack is so badly corroded that it cannot last more than one year longer. For these reasons it is earnestly recommended that new benches and a new melting plant be installed during the coming summer.

The Mechanical Laboratory building is, both externally and internally, in better condition than formerly; new floors in the Machine-Tool and Wood Turning Laboratories are needed, the present ones being too unsteady for good machine work. The lighting is not sufficiently good to enable exact work to be done, and the present inadequate gas-lighting system, which was installed in haste in 1884, should be replaced by a modern electric-lighting system.

Two assistants have resigned: Marshall G. Merriam, Assistant in Chipping and Filing, has taken the position of Director of Evening School Work of the Providence Young Men's Christian Association; Oscar W. Northrup, Assistant in Machine-Tool Work, has taken the position of Assistant Superintendent of the Chandler Planer Co.; Ernest Curley, a former student in Drawing and Mechanic Arts, has been appointed Assistant in Machine-Tool Work; and Alfred R. Hunter, a former special student in Mechanical Engineering with considerable practical experience, has been appointed Assistant in Chipping and Filing.

PETER SCHWAMB.

DEPARTMENT OF ENGLISH.

The English Department has during the past year put into operation a new plan of grading the students in first-year work. In the tabular view the sections are divided into three large groups, and in each of these groups the sections have been graded according to the proficiency shown in their entrance examination papers and in the first written exercises of the term. This affords opportunity for adjusting the work of any given class to what are practically the needs and capacity of all the students. Much effort is likely to be wasted in any college first-year class on account of the widely varied training of boys who come from schools of unequal efficiency. It is not possible entirely to overcome this difficulty by any grading founded upon entrance marks, yet that test is sufficiently accurate to give results better than those possible under old methods. The system becomes much more valuable, moreover, when it is applied to the second term. Here the grading of classes is guided by the results of the first term. Sections able to advance rapidly are taken forward, while in those which must go slowly this method makes possible that slow and gradual progression which is not practical when the class has an upper half or third impatient to advance. As the

system is used and developed, it seems likely to be of much value in the line of economy and efficiency.

The Department has in foreign students a problem which becomes each year more complicated. While theoretically every student admitted to the Institute understands and speaks English, it has more than once happened that an instructor has found it necessary to make explanations to especial students in French, Spanish, or German. The Department does not include á master of Oriental tongues, and since to the Institute come every year a number of students born to a variety of languages of the East, the matter is one which sometimes requires no little care.

The new system of entrance examinations has thus far worked excellently. The results of the freer and less mechanical literary training in the secondary schools made possible by the change in the Institute requirements are already beginning to show; and it is to be hoped that in the future this will become more and more marked.

To the staff has been added as Assistant Mr. Allen French, of the class of 1892, Course IX., the first Institute graduate to come into the Department. Mr. French is known as the author of a number of books, and has practical knowledge of the subjects which he teaches. This addition to the force is in part made necessary by the steady increase in consultation and conference work which distinguishes the English work in all its branches.

ARLO BATES.

DEPARTMENT OF HISTORY AND POLITICAL SCIENCE.

For several years a considerable amount of written work has been required in first-year United States History, with two objects in view: first, to ensure regular and due apportionment, week by week, of the time allowed for preparation; and, secondly, to give students needed practice in English composition. In both of these respects the plan has produced good results.

In second-year European History an increased allowance of time for preparation has already been made in the Courses in Civil and Mechanical Engineering and Naval Architecture, to which the Course in Electrical Engineering will be added next year. Accordingly, beginning next year, the same scheme of written work will be introduced in European History for students in these Courses, and subsequently for other students in case additional time for preparation is provided for in their respective Courses.

The courses in the History of European Civilization and Art have profited during the past year by a large increase in illustrative material. In addition to the extensive collections of the Department of Architecture, the series of photographs and of lantern slides of sculpture, paintings, maps, etc. which is being specially formed with reference to the needs of these courses has been much enlarged and now numbers upwards of six thousand. The increase in the collection of lantern slides is particularly welcome, since the efficiency of lectures dealing with matters of art is necessarily dependent upon adequate illustration. The photographs are at present being arranged and catalogued. Their usefulness is somewhat hampered by insufficient storage space, but it is hoped that additional cabinets may soon be provided.

Besides the two longer courses in this subject, planned with special reference to the needs of students in the Department of Architecture, an elective course on "European Civilization

and Art in its most famous Epochs" was given last year for the first time. In this course, which is intended for students other than those in the Architectural Department, the aim is to describe in outline the conditions and dominant forces of civilization in a few of its more brilliant periods, and to show characteristic examples of their art. Particular attention is given to making clear the elements of the great architectural styles.

CHARLES F. A. CURRIER.

DEPARTMENT OF ECONOMICS.

The Department of Economics has been called upon to co-operate this year in the establishment of a new and promising experiment in practical sociology. Professor Carroll W. Doten, in addition to his regular duties at the Institute, is acting as head of the Research Department recently established at the School for Social Workers in this city. Under his supervision three subjects are being studied, namely: (1) co-operation in its various forms; (2) seasonal and irregular employments; and (3) inebriety. This last subject is being approached from two points of view, or rather is the point of departure for two separate lines of investigation, namely: the study of individual cases and the methods of treatment in hospitals, penal institutions, and under the probation system; and a careful inquiry into the effects of license and no-license in several Massachusetts cities under our local option law.

D. R. DEWEY.

DEPARTMENT OF MODERN LANGUAGES.

Since I rendered my last annual report, the requirements in Modern Languages have been diminished for undergraduates in the Courses in Electrical Engineering and Naval Architecture. In five of the thirteen Courses but one language (above elementary grade) is now required for graduation, and

this language is left to the choice of the student. As the language requirements diminish, the average grade of the Courses tends to rise. In the Course in Electrical Engineering a year of French II. with a term of French III. has been substituted for a year of French II. and a year of German II. A similar change is to be expected in one or more other Courses. For the present year the Department is giving instruction in German I. to two sections, numbering together 39 pupils.

The work of the Department and its distribution among the Subjects is shown in the following table:—

Subject.	Sections.	Students.
Italian	1	3
French II.	10	243
French III.	2	8
French Colloquium	1	23
German I.	2	39
German II.	14	167
German III.	1	23
German Colloquium	2	26
Spanish I	2	56
Spanish II.	2	7
Spanish Option	1	15
Totals	38	610

Size of Average Section	16.2
Number of Students taking French	274
Number of Students taking German	255
Number of Students taking Spanish	78
Number of Students taking Italian	3

Last year the average section in Modern Languages numbered 18 students. This year it comes within two of that number. There are still four sections that number more than 25. Fifteen is considered a proper maximum.

As the time allowed to Modern Language study is diminished, the instruction should, if possible, be correspondingly increased in effectiveness. The present comparative smallness of the sections, allowing a closer contact between the students and the instructors, together with the attendant rise in the grade of the courses, points to a stronger personal influence, and

suggests a higher grade of work, on the part of the instructors; and may warrant or call for an increase in the salaries paid or allowed them. To provide for such an increase without augmenting the budget of the Department, it may be well to take advantage of the next vacancy in the instructing staff to make a permanent reduction of its force.

The experiment of having summer reading in foreign languages, as well as in English, was repeated last year with the results indicated in the following table:—

Year.	No. of Reports Received.	No. of Foreign Books Read.	No. to Every 10 Students.	
			1906.	1907.
First	246	30	1.17	1.22
Second	149	20	1.29	1.34
First and second	395	50	1.23	1.27

JOHN BIGELOW, JR.

The Society of Arts.

To the President of the Massachusetts Institute of Technology:

Sir,—From time to time it is well to pause to consider the objects of our endeavor and how far we are attaining them. In the "Objects and Plan of an Institute of Technology" (Edition 2, 1861), President Rogers points out the connection between industrial progress and an enlarged acquaintance with the objects and phenomena of nature and with physical laws, and he speaks of the benefit which the most enlightened communities of Europe have obtained from this practical co-operation of education and the arts by the establishment of museums, societies, and colleges of technology. He says: "With the view of securing the great industrial and educational benefits above alluded to, it is proposed to establish, on a comprehensive plan, an institution devoted to the practical arts and sciences, to be called the Massachusetts Institute of Technology, having the triple organization of a society of arts, a museum or conservatory of arts, and a school of industrial science and arts."

It will be seen that in the plan the Society of Arts was placed first, and in regard to it President Rogers says that "under the first of these characters" the Institute would form itself into a department of investigation and publication intended to promote research in connection with industrial science by the exhibition at the meetings of the society of new mechanical inventions, products, and processes, by written and oral communications and discussions, as well as by more elaborate treatises on special subjects of inquiry. Another line of activ-

ity proposed was the publication of a series of reports exhibiting the conditions of the departments of industry, with the progress of practical discovery in each and the discussion of the scientific questions involved. In order to carry out these plans for publication, it was proposed to found a journal, which, it was hoped, would be a powerful means for advancing the interests of the industrial arts and practical education.

With these plans the Society of Arts was founded, and it is with these objects in view that we have continued our activities until the present day. Advance in complexity and specialization of the various arts and sciences have resulted, however, in the formation of many special societies and in the publication of journals devoted to narrow lines of science and industry. There still remains, however, in every community the need of bringing to the attention of those who are not specialists the advances in arts and sciences which may have an influence upon the life of the people. This function may very well be filled for Boston by the Society of Arts. That we are accomplishing this object to some extent is shown by the gratifyingly large attendance in our meetings.

We have in the *Technology Quarterly* a journal which aims to fulfil the objects of the founder in regard to publication. This is done in two ways: first, by printing the proceedings of the Society of Arts, and so far as possible publishing in full the communications that have been presented to the Society; second, by publishing original papers, giving the results of investigations carried on in the laboratories of the Institute. In fulfilling the second function the *Technology Quarterly* is hampered by two circumstances, the most serious of these being that the investigators generally desire to publish their results in journals devoted especially to the sciences or arts to which they appertain. In order that the *Technology Quarterly* might be more truly representative of the work done in the Institute, a special committee of the Faculty and the Board of Publication, sitting as a joint committee, recommended the following resolution:—

That in future every member of the instructing staff be requested to send to the Editor of the *Technology Quarterly* a full and exact title of every volume or paper published by himself as soon as this appears. With such title he shall also be requested to send a concise and comprehensive abstract or description of the volume or paper, and if possible a copy of the same as printed. Some papers might, perhaps, be reprinted in the *Quarterly*, but in general only the title and abstract will be given.

This resolution was adopted by the Faculty, and in co-operation with the Editor the Faculty Committee on Publications have sent out circulars in pursuance of the above resolution, and this department of titles and abstracts appeared for the first time in the *Technology Quarterly* for June, 1907.

The second difficulty is that lack of sufficient funds makes it impossible to print in full the results of many investigations, which consequently appear elsewhere.

During the past year the Editor has been fortunate in securing an unusually large number of papers read before the Society for publication in the *Quarterly*, and also a number of papers presented to classes of students by distinguished visitors. Besides these, several of the departments have made valuable contributions, and the book reviews continue to be an interesting feature.

During the year there have been thirteen lectures delivered before the Society, as follows:—

October 28, 1906. Dr. George W. Pierce, "The Wave Lengths in Wireless Telegraphy."

November 8, 1906. William Lyman Underwood, "The Work of the River Drivers in the Maine Woods."

November 22, 1906. Dr. George A. Soper, "The Air of the New York Subway."

December 13, 1906. A. E. Brown, "The Application of Hoisting Machinery to Shipbuilding."

December 27, 1906. Richard L. Humphrey, "The California Earthquake."

January 10, 1907. H. E. Warren, "The Governing of High Pressure Water Wheels."

January 24, 1907. Dr. Walter E. Winship, "Storage Battery Regulations."

February 14, 1907. F. L. DuBosque, "The Marine Interests of a Railroad."

February 28, 1907. Edward S. Cole, "Water Works Losses, and the Use of the Photo-Pitometer."

March 14, 1907. Professor A. H. Sabin, "Paint as a Preservative Coating."

March 28, 1907. Dr. L. A. Bauer, "Recent Results of Terrestrial Magnetic Observations."

April 11, 1907. Hon. Willard Howland, "The Cape Cod Canal."

April 25, 1907. Frank M. Gilley, "Preparatory Trade Instruction in Holland, and the Instrument Makers' School in the University of Leyden."

May 9, 1907. W. R. Warner, "The Panama Canal."

The meetings have been advertised, with two or three exceptions, in the *Saturday Evening Transcript* on the Saturday preceding the lecture, but it is questionable if the attendance has been largely increased in this manner.

The attendance at the meetings has been comparatively good, the smallest number about twenty-eight and the largest one hundred and forty. Sixty seems to be the average attendance.

The membership of the Society has been decreased during the past year by ten. One new member has been elected and one cannot be found, no address being known. At present there are on the books of the Secretary three hundred and six names. Of these, fifty-four are in arrears to the extent of two years of more, the sum total of the delinquent dues amounting to $774. Since September, $921 have been collected—$729 dues of the current year and $192 arrears, varying in sums from $6 to $24. A personal letter of appeal has been sent to each of the delinquents, and it is believed that persistent efforts will result in the collection of at least half of the amount still due.

For the Executive Committee,

EDMUND H. HEWINS, *Chairman.*
WALTER S. LELAND, *Secretary.*

Publications.

CIVIL ENGINEERING.

GEORGE F. SWAIN.—Report to the Massachusetts Railroad Commission on Steam Railroad and Street Railway Bridges in Massachusetts. In *Report of Railroad Commissioners for* 1907.

FRANK P. MCKIBBEN.—Tension Tests of Steel Angles with Various Types of End Connections. Presented to American Society for Testing Materials, June, 1907. *Engineering News*, 1907.

GEORGE E. RUSSELL.—Notes on Hydraulics. Prepared for the use of students at the Institute.

MECHANICAL ENGINEERING.

G. LANZA.—Some Tests of Full-size Locomotive Connecting Rods. *Proceedings American Society for Testing Materials*, 1907.

G. LANZA.—Report of Committee on Standard Methods of Tests. *Proceedings American Society for Testing Materials*, 1907.

G. LANZA.—Discussion of "A Plan to provide a Supply of Skilled Workmen" by M. W. Alexander. *Proceedings American Society of Mechanical Engineers*, 1906–07.

C. F. PARK.—Discussion of "College and Apprentice Training" by J. P. Jackson. *Proceedings American Society of Mechanical Engineers*, 1906–07.

CHEMISTRY AND CHEMICAL ENGINEERING.

H. P. TALBOT and A. A. BLANCHARD.—Electrolytic Dissociation Theory. Second Edition. New York, Macmillan Co., 1907.

H. P. TALBOT.—See A. G. Woodman.

A. A. NOYES.—Institute Graduates at German Universities. *Technology Review*, Vol. VIII., No. 2, pp. 197–205.

W. H. WALKER.—The Chemistry of Cellulose. *Journal Franklin Institute*, Vol. CLXIV., p. 131. *Textile Colorist*, Vol. XXIX., p. 242.

W. H. WALKER.—The Annealing of Sterling Silver. *Journal of the American Chemical Society*, Vol. XXIX., p. 1198.

W. H. WALKER (with ANNA M. CEDERHOLM and L. N. BENT).—The Corrosion of Iron and Steel. *Journal of the American Chemical Society*, Vol. XXIX., p. 1251.

W. H. WALKER and COLBY DILL.—The Effect of Stress upon the Electromotive Force of Iron. *Transactions of the American Electrochemical Society*, Vol. XI., p. 153.

W. H. WALKER (with COLBY DILL).—The Influence of Stress upon the Corrosion of Iron. *Proceedings of the American Society for Testing Materials*, Vol. VII., p. 150.

HENRY FAY.—Determination of Sulphur in Pyrite. *Technology Quarterly*, Vol. XX. (1907), p. 27.

HENRY FAY.—Tellurium-Tin Alloys. *Journal of the American Chemical Society*, Vol. XXIX. (1907), p. 1265.

A. H. GILL.—A Comparison of Apparatus for Testing the Liability of Oils to produce Spontaneous Combustion. *Journal of the Society of Chemical Industry*, Vol. XXVI., p. 185.

A. H. GILL (with P. C. MCILHINEY, A. C. LANGMUIR, MAXMILIAN TOCH, and MAX WALLERSTEIN).—Report of the Sub-committee on Shellac Analysis. *Journal of the American Chemical Society*, Vol. XXIX., p. 1221.

A. H. GILL (with CHARLES R. HAYNES).—The Probable Efficiency of Accidental Gas Explosions. *Journal of the American Chemical Society*, Vol. XXIX., p. 1482.

A. H. GILL.—Engine Room Chemistry. New York and London, Hill Publishing Company, 1907, 8vo, p. 187.

M. S. SHERRILL (with F. M. EATON, A. MERRILL, and D. E. RUSS).—Equilibrium Relations of Chromates in Solutions. *Journal of the American Chemical Society*, Vol., XXIX. (1907).

E. H. RICHARDS.—Air Supply Examination. *Papers and Reports of the American Public Health Association*, Vol. XXXII., Part II. Meeting of 1906, published in 1907.

E. H. RICHARDS.—Sanitation in Daily Life. Whitcomb & Barrows, November, 1907.

E. H. RICHARDS.—Chemistry of Cooking and Cleaning. New Edition. 1907.

E. H. RICHARDS.—Address, Association of Collegiate Alumnæ, Quarter Centennial Meeting. Desirable Tendencies in Professional and Technical Education. *Association of Collegiate Alumnæ Magazine*, Anniversary number, 1907.

A. G. WOODMAN and H. P. TALBOT.—The Fluorine Content of Malt

Liquors. *Journal of the American Chemical Society*, Vol. XXIX., p. 1362.

A. A. BLANCHARD.—Inorganic Preparations. A Laboratory Course in the Chemistry of the Metallic Elements. 8vo. p. 80. Printed for students' use, not yet published.

A. A. BLANCHARD.—See H. P. Talbot.

R. S. WILLIAMS.—Ueber die Legierungen des Antimons mit Mangan, Chrom, Silicium und Zinn; des Wismuts mit Chrom und Silicium und des Mangans mit Zinn und Blei. *Zeitschrift für anorganische Chemie*, Vol. LV. (1907), I.

E. B. SPEAR.—Die katalytische Zersetzung des H_2O_2 unter hohen Sauerstoffdrucken. Doctor-dissertation, Heidelberg University, 1907.

E. B. SPEAR.—The Catalytic Decomposition of Hydrogen Peroxide under High Pressure of Oxygen. *Journal of the American Chemical Society*, 1907.

RESEARCH LABORATORY OF PHYSICAL CHEMISTRY.

Serial Publications of the Research Laboratory.

No. 15.—The Specific Heat of Solids at Constant Volume, and the Law of Dulong and Petit. By G. N. Lewis. *Journal of the American Chemical Society*, Vol. XXIX., pp. 1165–1168, 1907.

No. 16.—On the Density, Electrical Conductivity, and Viscosity of Fused Salts and their Mixtures. By H. M. Goodwin and R. D. Mailey. *Physical Review*, December, 1907.

No. 17.—Outlines of a New System of Thermodynamic Chemistry. By G. N. Lewis. *Proceedings of the American Academy of Arts and Sciences*, Vol. XLIII., pp. 259–293, 1907.

No. 18.—Solutions of Metals in Non-metallic Solvents. I. General Properties of Solutions of Metals in Liquid Ammonia. By C. A. Kraus. *Journal of the American Chemical Society*, Vol. XXIX., pp. 1557–1570, 1907.

No. 19.—The Electrical Conductivity of Aqueous Solutions. *Publications of the Carnegie Institution of Washington*, No. 63, pp. 1–352, 1907. Part I., by A. A. Noyes; Part II., by A. A. Noyes and W. D. Coolidge; Part III., by W. D. Coolidge; Part IV., by A. A. Noyes and A. C. Melcher; Part V., by A. A. Noyes and H. C. Cooper; Part VI., by A. A. Noyes and Y. Kato; Part VII., by R. B. Sosman; Part VIII., by A. A. Noyes and G. W. Eastman; Part IX., by C. W. Kanolt; Part X., by W. Böttger; Part XI., by A. A. Noyes and Y. Kato; Part XII., by A. A. Noyes.

Other Publications of the Research Staff.

C. L. VON ENDE.—A translation of Abegg's "The Electrolytic Dissociation Theory." John Wiley & Sons, New York, 1907.

C. L. VON ENDE (with K. E. GUTHE).—Standard Cells. *Physical Review*, Vol. XXIV., pp. 214–221, 1907.

ELECTRICAL ENGINEERING DEPARTMENT.

DUGALD C. JACKSON.—College Graduates and Central Stations. *Electrical World and Engineer*, Vol. XLIX., pp. 220–221, February, 1907.

DUGALD C. JACKSON.—Methods of Electric Lighting for Railway Trains. Read before the Western Society of Engineers, May 15, 1907. (Illustrated.) *Journal of the Western Society of Engineers*, Vol. XII.

DUGALD C. JACKSON.—The Relations of the Engineering Schools to Polytechnic Industrial Education. Address of the President of the Society for the Promotion of Engineering Education, July 2, 1907. *Proceedings of the Society*, Vol. XV.; *Science*, Vol. XXVI., pp. 104–111.

DUGALD C. JACKSON.—Report on the Telephone Situation in the City of Chicago; in respect to Service, Rates, Regulation of Rates, etc. By a Special Commission, Dugald C. Jackson, Chairman, William H. Crumb, and George W. Wilder. Chicago, April 31, 1907.

H. E. CLIFFORD.—The Moore Tube System of Lighting. Read before the New England Section, Society of Illuminating Engineers, March 12, 1907. *Proceedings of the Society*, Vol. II.; *The Illuminating Engineer*, Vol. II., pp. 161–163.

GEORGE C. SHAAD.—Abstracting Engineering Papers. *Electric Journal*, Vol. IV., pp. 83–85, February, 1907.

GEORGE C. SHAAD.—Loading Stationary Induction Apparatus. (Illustrated.) *Electric Journal*, Vol. IV., pp. 346–357, June, 1907.

GEORGE C. SHAAD.—Section X., Central Stations (joint author). (Illustrated.) Standard Handbook for Electrical Engineers. New York, McGraw Publishing Company.

GEORGE C. SHAAD.—Notes on Power Transmission. For use of Course VI. students, Massachusetts Institute of Technology.

HARRISON W. SMITH.—Notes on the Characteristic Curves of the Direct-current Machine. (Illustrated.) *Technology Quarterly*, Vol. XX., pp. 119–132, March, 1907.

CHARLES H. PORTER.—Notation for Polyphase Circuits. (Illustrated.) *Electric Journal*, Vol. IV., pp. 497–505, September, 1907.

BIOLOGY, AND SANITARY RESEARCH LABORATORY AND SEWAGE EXPERIMENT STATION.

W. T. SEDGWICK.—On the Protection of Public Water Supplies from Pollution during Construction, Maintenance, and Operation of Railroads; with Special Reference to the Water Supply of Seattle, Washington; and Criticisms of the Present Methods of Water Supply and Sewerage of Railway Trains. *Journal of the New England Water Works Association*, Vol. XX., No. 4, December, 1906.

W. T. SEDGWICK.—Address of Welcome as President New England Water Works Association to the President and Members of the American Water Works Association, in Huntington Hall, July 10, 1906. *Proceedings of the Twenty-sixth Annual Convention of the American Water Works Association for* 1906, pp. 557–562.

W. T. SEDGWICK.—The Expansion of Physiology. Address of the Vice-President and Chairman of Section K, Physiology and Experimental Medicine, New York Meeting A. A. A. S., 1906. *Proceedings A. A. A. S. for* 1906; *Science*, N. S., Vol. XXV., No. 635, pp. 332–337, March 1, 1907.

S. C. PRESCOTT.—Commercial Bacteriological Inspection of Milk and its Results. *Science*, Vol. XXV., No. 647, pp. 814–815.

S. C. PRESCOTT.—The Canning Industry. Wine and Cider Manufacture. Vinegar. The Alcoholic Fermentation: Ale and Beer. Articles in the *American Cyclopedia of Agriculture* (*in press*).

S. C. PRESCOTT.—Commercial Bacteriological Inspection of Milk. *Bulletin State Board of Health of Massachusetts*, July, 1907.

S. C. PRESCOTT.—Inspected Milk. (A Brochure for Physicians.) Boston, 1907.

C.-E. A. WINSLOW.—The Teaching of Biology and Sanitary Science in the Massachusetts Institute of Technology. *Technology Quarterly*, Vol. XIX., No. 4, pp. 416–425, December, 1906.

C.-E. A. WINSLOW.—Disposal of Sewage. *Bulletin No. 1, Vol. VIII., of the Vermont State Board of Health*, September 1, 1907.

C.-E. A. WINSLOW.—Review of Legislation as to Public Health and Safety. *Thirty-third* (*Legislation*) *Bulletin of the New York State Library for* 1906, p. 45, Albany, N.Y., 1907.

C.-E. A. WINSLOW (with E. B. PHELPS, C. F. STORY, and H. C. MCRAE). Studies of Sewage Distributors for Trickling Filters. *Technology Quarterly*, Vol. XX., pp. 325–374.

C.-E. A. WINSLOW.—See E. B. Phelps.

E. B. PHELPS (with W. T. CARPENTER).—The Sterilization of Sewage Filter Effluents. *Technology Quarterly*, Vol. XIX., pp. 382–403, December, 1906.

E. B. PHELPS (with C.-E. A. WINSLOW).—On the Use of Methylene Blue in Testing Sewage Effluents. *Journal of Infectious Diseases*, Supplement No. 3, pp. 1–13, May, 1907.

E. B. PHELPS.—The Prevention of Stream Pollution by Strawboard Waste. United States Geological Survey Water Supply Paper No. 189. *Technology Quarterly*, Vol. XX., p. 292.

E. B. PHELPS.—Report to the New Jersey State Sewerage Commission on an Outbreak of Typhoid Fever at the State Hospital for the Insane at Trenton. *Engineering News*, Vol. LVIII., No. 14, pp. 353, 354, Oct. 3, 1907.

E. B. PHELPS.—See C.-E. A. Winslow.

A. W. WEYSSE.—Eine anatomisch-physiologische Studie des Brust-Korbes vermittelst des Brust-Pantographen. Fr. Reinhardt. *Universitäts-Buchdruckerei*, Basel, July, 1907.

W. L. UNDERWOOD.—Some Personal Experiences with the Gypsy and the Brown-tail Moth. *American Journal of Public Hygiene* and *Journal Massachusetts Association of Boards of Health*, Vol. XVI., pp. 569–590.

C. F. STORY.—See C.-E. A. Winslow.

H. C. MCRAE.—See C.-E. A. Winslow.

F. A. WOODS.—The Non-inheritance of Sex in Man. *Biometrika*, Vol. V., Parts I. and II., pp. 73–78.

PHYSICS.

H. M. GOODWIN. See Publications of Research Laboratory of Physical Chemistry.

C. L. NORTON. Asbestos Wood. *Electrical World*, Vol. XLIX., 1907, p. 835.

C. L. NORTON.—Asbestos Wood. *Insurance Engineering*, Vol. XIII., March, 1907.

C. L. NORTON.—A New Fire Retardent. *Insurance Engineering*, Vol. XIII., April, 1907.

C. L. NORTON.—Asbestos Wood. *The Indian Electrical, Mechanical, and Textile News*, Bombay, India, October, 1907, Vol. V., No. 2, p. 45.

CHARLES J. EMERSON.—The Effect of Oil in the Cylinder of an Internal Combustion Motor. *The Horseless Age*, Vol. XIX., p. 554, 1907.

D. F. COMSTOCK.—Experimental Investigation of the Effect of Perma-

nent Magnetism in Iron on the Permeability for very Small Forces. Inaugural Dissertation, University of Basel, 1906.

A. E. GREENE and F. S. MACGREGOR.—The Electrothermic Reduction of Iron Ores. *Electrochemical and Metallurgical Industry*, Vol. V., 1907, p. 367.

GEOLOGY.

CHARLES H. CLAPP.—The Clays of North Dakota. Fourth Biennial Report. *Geological Survey of North Dakota*, 1907.

CHARLES H. CLAPP.—The Clays of North Dakota. *Economic Geology*, Vol. II., No. 6.

REGINALD A. DALY.—The Limeless Ocean of pre-Cambrian Time. *American Journal of Science*, February, 1907.

R. A. DALY.—Report on Field Operations in the Geology of the Mountains crossed by the International Boundary (49th Parallel). In Report of the Chief Astronomer, Department of the Interior, Ottawa, Canada, 1907.

HERVEY W. SHIMER (with A. W. GRABAU).—Index Fossils of North America, Part II. *School of Mines Quarterly*, New York, 1907.

HERVEY W. SHIMER.—A Lower-middle Cambrian Transition Fauna from Braintree, Mass. *American Journal Science*, Vol. XXIV., pp. 176–178, 1907.

HERVEY W. SHIMER.—Geology of Connecticut (book review). *Technology Quarterly*, Vol. XX., pp. 375–378, 1907.

HERVEY W. SHIMER.—The Broad Features of the Geologic History of North America in Diagram. *Technology Quarterly*, Vol. XX., pp. 287–291, 1907.

HERVEY W. SHIMER.—An Almost Complete Specimen of Strenuella Strenua (Billings). *American Journal Science*, Vol. XXIII., pp. 199–201, p. 319, 1907.

NAVAL ARCHITECTURE.

C. H. PEABODY.—Thermodynamics of the Steam Engine, etc. (rewritten). New York, John Wiley & Sons, 1907.

C. H. PEABODY.—Tables of the Properties of Steam and Temperature Entropy Table (partly recomputed and partly new). New York, John Wiley & Sons, 1907.

WILLIAM HOVGAARD.—Article on the Speed of Battleships. Read before the International Congress of Naval Architects in Bordeaux, France.

Proceedings of the Society of Naval Architects and Marine Engineering, 1907.

W. S. LELAND and H. A. EVERETT.—Test on the Steamship "Governor Cobb." Read before the Society of Naval Architects and Marine Engineering. *Proceedings of the Society of Naval Architects and Marine Engineering*, 1907.

MATHEMATICS.

FREDERICK S. WOODS and FREDERICK H. BAILEY.—A Course in Mathematics, Vol. I. Boston, Ginn & Co., 1907.

GEORGE A. OSBORNE.—Differential and Integral Calculus. Revised edition. Boston, D. C. Heath & Co., 1907.

CLARENCE L. E. MOORE.—Circles Orthogonal to a Given Sphere. *Annals of Mathematics*, January, 1907.

ECONOMICS.

DEWEY, D. R.—National Problems. In the *American Nation Series*. Harper & Brothers, New York, 1907.

DEWEY, D. R.—Financial History of the United States. Third edition and revised. Longmans, Green & Co., New York, 1907.

DEWEY, D. R.—Review of Burton's "John Sherman." *American Historical Review*, July, 1907, p. 905.

Massachusetts Institute of Technology

BOSTON

REPORT OF THE TREASURER

FOR THE YEAR ENDING SEPTEMBER 30, 1907

December, 1907

Report of the Treasurer.

The Treasurer submits the annual statement of the financial affairs of the Institute for the year ending September 30, 1907.

It may not be uninteresting at this time to compare the financial condition of the Institute sixteen years ago with that of to-day. The following table shows in concise form some of the principal items in 1891 and in 1907:—

	1891.	1907.
Total property both real and personal	$1,364,684.98	$3,957,129.88
Total students	937	1,410
Fees from students and Scholarship Funds	$182,088.00	$331,669.50
Salaries, including instruction, lectures, administration, and labor	$160,229.95	$383,481.28
Department Supplies	25,857.92	54,616.44
Repairs	6,948.66	5,816.55
General Expenses	9,180.83	17,315.03
Total Expenditure	238,676.91	510,069.50

From the above figures it will be seen that the number of students has increased over 50 per cent. Fees from Student and Scholarship funds, over 82 per cent. Salaries over 139 per cent., and total expenditure of all kinds more than 113 per cent. This increase in total expenses is not caused by any one class of expenditures, but is distributed throughout most of them. For instance, it will be noted that the amount for department supplies has more than doubled, and that the item "General Expenses" is nearly twice what it was.

In the matter of repairs, there was a large expenditure in the year 1906, and the cost this year may be considered abnormally low. In 1906 the amount for repairs was decidedly more than double that in 1891.

The increase in the total property of the Institute has been large, being nearly 190 per cent., but it must be borne in mind that of the total amount more than one half is in the form of real estate and scholarship funds, and another large portion

is represented by equipment and by special trust funds which do not contribute to meet the expenses of the Institute. The main reliance is therefore on the tuition fees, and in spite of the advance made some years since, raising the fee to $250 per annum, the increase in expenditure has far outstripped the increase in tuitions. This is easily explained by the higher educational requirements which now prevail; by the larger proportion of students in the upper classes; by the better facilities now offered and the increased cost of instruction and supplies. Expenditures have been rigidly scrutinized and many economies have been introduced, for which much credit should be given to our Bursar, Mr. F. H. Rand, but the fact remains that the requirements are much higher to-day than they were sixteen years ago. The generous aid of the alumni, amounting this year to $46,588.04, has made possible many much-needed expenditures which will be referred to hereafter, but this income, like much of that from the State, is pledged for only a few years. The need for endowment is most pressing, and should appeal to all who feel the importance to the community of the higher technical education.

The following gifts and legacies have been received during the year, and call for the sincere thanks of the Institute:—

Income Committee	$46,588.04
Legacy under the will of the late Charles Merriam	25,000.00
Legacy under the will of the late Alexander S. Wheeler	5,000.00
From an anonymous friend a further payment for the Sanitary Research Fund	5,000.00
From Dr. A. A. Noyes for Physico-Chemical Research	3,000.00
Additional Amount under the will of the late Thomas Gaffield	2,000.00
From Charles G. Weld, M.D., for the department of Naval Architecture	1,400.00
From the Saturday Club for the purchase of books	1,000.00
From the Caroline A. R. Whitney estate, for seismographic apparatus	750.00
From Mrs. William B. Rogers for the Department of Geology	500.00
And for the purchase of periodicals	225.00
From an anonymous friend for salaries	500.00
From the William E. Hale Research Fund, for Physico-Chemical Research	500.00
Additional payment under the will of the late Susan E. Dorr	440.40
From A. D. Little, Esq., for salaries in the Chemical Department	300.00
From Mrs. Henry Pickering, for the Department of History	100.00
Additional payment under the will of the late Macy S. Pope	28.81

In addition to these pecuniary gifts there have been made for the equipment of various Departments generous contributions, which should be brought to the attention of the Corporation.

The Institute has received from the American Bridge Company 27 pictures, mounted and framed; from Mr. Arthur Winslow a number of books and pamphlets; from Mr. H. M. Whitney fireproofing material for the Laboratory of Sugar Analysis; from Mr. Henry A. Morss a Sullivan universal shunt box; from the American Telephone & Telegraph Company various small pieces of apparatus; from the Western Electrical Company exhibit-specimens of telephone apparatus; from Mr. Charles A. Clarke a Wright & Henry two-spindle high-speed drilling machine; from the American Gas Furnace Company an oil tempering furnace; from the Brown & Sharpe Manufacturing Company a universal grinding machine; from the Becker-Brainard Milling Machine Company a universal milling machine; from the Pratt & Whitney Manufacturing Company a 13-inch engine lathe; from S. F. Bowser & Company a two-compartment glass-front oil cabinet; from the Starrett Company a mine pump; from the Westinghouse Machine Company and other friends a contribution for the acquirement of a steam-turbine of 500 kilo-watt capacity; from the American Superheater Company a contribution for a superheater; from the Baldwin Locomotive Works and the American Locomotive Company complete sets of blue prints of locomotives; from the Fitchburg Machine Tool Company, the B. F. Sturtevant Company, and the Napier Motor Company of America valuable apparatus for use in connection with work in the drawing-room; from members of the Instructing Staff and Alumni numerous mineralogical and petrographical specimens; from Mr. Fred L. Franks a large collection of tertiary shells; from the Philadelphia Academy of Science a collection of lower tertiary forms.

It is proper to make special reference to the great assistance furnished by the Income Fund Committee. Had the whole of the money contributed from this source been used for this

year's expenses, this report would have shown a surplus of several thousand dollars instead of a deficit, in the current expense account, but it has been felt that the wishes of the alumni would best be carried out by devoting their gifts so far as possible to special matters of development rather than to mere maintenance. Accordingly, besides paying during the past year for special apparatus for the Mechanical Engineering Department and for the Electrical Engineering Department, and besides salary payments to strengthen the instructing staff, there has been reserved the sum of $10,000 to be applied during the coming year to certain special purposes, such as the purchase of a steam turbine and the extension of the plan of personal conferences between first-year students and the instructors, in which matters various alumni have expressed a special interest.

The Walker Memorial contributions are technically held as a separate fund, and are not strictly to be included in the accounts of the Institute, but for the information of the alumni there is given in the present report a list of the securities held for that fund, and a statement of its total amount, which with accrued interest at the time of this report is $112,033.40.

GEORGE WIGGLESWORTH, TREASURER, *in account with*
GENERAL STATEMENT OF RECEIPTS AND DISBURSEMENTS

Dr.

Cash balance, Sept. 29, 1906		$118,865.79
RECEIPTS FOR CURRENT EXPENSES.		
Income of funds for salaries	4,324.00	
" " " " Fellowships	1,800.00	
" " " " scholarships (students' fees)	10,125.00	
" " " " Joy "	62.50	
" " " " W. B. Rogers Scholarships	625.00	
" " " " Library	480.00	
" " " " general purposes	31,350.33	
" " Rogers Memorial Fund	10,850.50	
" " Charlotte B. Richardson Fund	1,495.15	
" " Rotch Prize Funds	400.00	
" " Rotch Architectural Fund	1,000.00	
" " Edward Austin Fund, Scholarships	7,750.00	
" " " " " Awards	3,935.00	
" " Teachers' Fund	2,350.00	
" " Ednah Dow Cheney Fund	570.00	
Students' fees	313,107.00	
State Scholarships	4,000.00	
United States Act of 1862	5,306.68	
United States Act of 1890	10,000.00	
Gift of State of Massachusetts	25,000.00	
Laboratory supplies and breakages	12,638.78	
Rents, per Table (page 12)	11,082.02	
Gifts	3,375.00	
Interest	4,659.68	
Sale Printed Lecture Notes	2,292.26	
Income Fund Committee $46,588.04 / Less Reserve shown below 10,000.00	36,588.04	505,166.94
GIFTS AND BEQUESTS FOR SPECIAL PURPOSES. (Page 14.)		6,611.26
GIFTS AND BEQUESTS FOR GENERAL PURPOSES. (Page 14.)		32,028.81
Income Fund Committee: Reserve for special uses next year		10,000.00
SECURITIES SOLD OR PAID.		
General Fund, page 14		44,740.00
SUNDRIES.		
Income credited to Bond Premium Acc't	3,851.50	
" " " Rogers Bond Premium Acc't	641.50	
Copley Society of Boston, on acc't	666.66	
Walker Memorial Fund	4,413.34	
Naval Architecture Fund	1,400.00	
Letter Box Fund	23.75	
Sanitary Research Laboratory Fund, additional	5,000.00	
Physico-Chem. Research Fund	3,500.00	
Notes Payable	19,034.75	38,531.50
		$755,944.30

MASSACHUSETTS INSTITUTE OF TECHNOLOGY.
FOR THE YEAR ENDING SEPT. 30, 1907.

Cr.

EXPENSES.

Salaries, per Table (page 12)	$383,481.28	
Edward Austin Fund, Awards	3,935.00	
Teachers' Fund "	2,350.00	
Prizes, Rotch Funds	400.00	
Fellowship paid from Savage Fund	500.00	
" " " Dalton Grad. Chem. Fund	500.00	
" " " Swett Fund	400.00	
" " " H. Saltonstall Fund	400.00	
Repairs to Buildings, per Table (page 13)	5,816.55	
General Expenses, per Table (page 13)	17,315.03	
Fire Insurance	3,146.04	
Fuel	16,832.38	
Water	3,010.30	
Gas	2,382.08	
Electricity	243.53	
Printing and Advertising	4,008.03	
" Lecture Notes	413.90	
" Annual Catalogues and Reports	5,740.79	
Physico-Chemical Research Fund	3,000.00	
Department Supplies and Repairs, per Table (page 12)	54,616.44	
Society of Arts	1,008.15	
Margaret Cheney Reading Room	570.00	$10,069.50

(Expenses more than Income, $4,902.56.)

SECURITIES BOUGHT OR RECEIVED AS LEGACIES.

General Fund, page 14	99,440.21

SUNDRIES.

Cabot Medal Fund	97.30	
Naval Architecture Fund	1,547.22	
Sanitary Research Laboratory Fund	5,244.68	
Physico-Chem. Research Fund	4,566.43	
Dormitory Fund	128.30	
New Gymnasium	20.64	
Roentgen-Ray Fund	25.00	
Notes Receivable	450.00	
Fees, in advance acc't	92,502.50	
Deposit, in advance acc't	7,049.44	
Accounts Payable, acc't	4,904.86	116,536.37
Cash balance, Sept. 30, 1907		29,898.22
		$755,944.30

E. and O. E.

GEORGE WIGGLESWORTH,
Treasurer.

The following acccunt exhibits the property held by the Institute, as per Treasurer's books, Sept. 30, 1907:—

INVESTMENT OF THE W. B. ROGERS MEMORIAL FUND.

31,000.00	N.Y. Central & H. R. R.R. Deb. 4s,	1934	30,225.00	
6,000.00	Baltimore & Ohio R.R. 3½s . . .	1925	5,310.00	
27,000.00	Kansas City Belt R.R. 6s	1916	27,000.00	
3,200.00	Republican Valley R.R. 6s	1919	3,200.00	
4,000.00	Cin.,Ind.,St. Louis & Chicago R.R.6s,	1920	4,000.00	
4,000.00	Kansas City,Fort Scott & Gulf R.R.7s,	1908	4,000.00	
1,000.00	Lincoln & Northwestern R.R. 7s .	1910	1,000.00	
1,000.00	Atchison & Nebraska R.R. 7s . .	1908	1,000.00	
35,000.00	Fort Street Union Depot 4½s . . .	1941	34,825.00	
24,000.00	Rome, Watertown & Ogdensburg R.R. 5s	1922	24,000.00	
37,500.00	Detroit, G. Rapids & Western R.R.4s,	1946	37,500.00	
25,000.00	Atchison, Top. & St. Fé R.R. 4s .	1995	24,470.00	
7,000.00	Chesapeake & Ohio R.R. 5s . . .	1939	7,000.00	
40,000.00	Chi. Junc. & Union Stock Yards 5s,	1915	40,000.00	
1,000.00	Wabash Equipment 4½s	1916	961.00	
	Advances to Bond Premium acc't .		5,553.00	
				250,044.00

INVESTMENTS, GENERAL ACCOUNT.

5,000.00	Bur. & Mo. River (Neb.) R.R. 6s, non-ex.	1918	5,000.00	
2,000.00	Bur. & Mo. River (Neb.) R.R. 6s, exempt	1918	2,000.00	
4,000.00	Chicago,Burlington & Quincy R.R.4s,	1922	3,100.00	
3,000.00	Hannibal & St. Joseph R.R. 6s . .	1911	3,000.00	
26,000.00	Am. Dock & Improvement Co. 5s .	1921	26,000.00	
3,000.00	Illinois Central R.R. 4s	1951	3,000.00	
6,000.00	Chi. Junc. & Union S. Yards 5s .	1915	6,000.00	
1,000.00	New England Tel. & Tel. Co. 6s .	1908	1,000.00	
100,000.00	West End Street Ry. 4s	1917	100,000.00	
50,000.00	Utah & Northern R.R. 1st 7s . . .	1908	50,000.00	
120,000.00	Illinois Steel Co., non-conv. 5s . .	1913	119,586.25	
43,000.00	Chesapeake & Ohio R.R. 5s . . .	1939	43,000.00	
100,000.00	Long Island R.R. 4s	1949	96,137.50	
7,000.00	K. C., Clinton & Springfield R.R. 5s,	1925	6,289.21	
8,500.00	K. C., Mem. & Birmingham R.R. 4s,	1934	8,287.50	
50,000.00	Kansas City Stock Yards 5s . . .	1910	50,000.00	
25,000.00	Atchison, Top. & St. Fé R.R. 4s. .	1995	25,000.00	
50,000.00	Rio Grande & Western R.R. 4s . .	1939	49,180.00	
50,000.00	Oregon R.R. & Navigation Co. 4s,	1946	50,000.00	
50,000.00	Union Pacific R.R. 4s	1947	50,000.00	
100,000.00	Chi. & W. Michigan R.R. 5s . .	1921	100,000.00	
105,000.00	American Tel. & Tel. Co. 4s . . .	1929	104,700.00	
50,000.00	New England Tel. & Tel. Co. 4s .	1930	50,000.00	
50,000.00	Chi. Junc. & Union S. Yards 4s .	1940	49,250.00	
50,000.00	K. C., Fort Scott & Memphis R.R.6s,	1928	50,000.00	
25,000.00	Southern Ry., St. Louis Div. 4s . .	1951	24,875.00	
7,000.00	Ozark Equipment Co. 5s	1910	7,000.00	
50,000.00	Northern Pac. Gt. Northern Joint 4s,	1921	48,500.00	
34,000.00	Baltimore & Ohio R.R. 3½s . . .	1925	30,090.00	
30,000.00	Chi., Mil. & St. Paul R.R. 7s . . .	1910	30,000.00	
52,000.00	N.Y. Cent. & H. R. R.R.(L. S.) 3½s,	1998	46,046.65	
50,000.00	Oregon Short Line 4s	1929	48,500.00	
5,000.00	Terminal Asso. St. Louis 4s . . .	1953	5,000.00	
3,000.00	Lake Shore & Mich. Southern 4s .	1928	3,000.00	
	Advances to Bond Premium acc't .		24,467.00	
	Carried up		1,318,009.11	
	Amount carried up			$250,044.00

Amount brought up					$250,044.00

INVESTMENTS, GENERAL ACCOUNT,—*Continued.*

Brought up				1,318,009.11	
33,000.00	American Tel. & Tel. notes 5s . .		1910	31,968.75	
20,000.00	Louisville & Nashville 4s		1923	19,750.00	
25,000.00	Mass. Electric Co. notes 4½s . . .		1910	24,500.00	
75,000.00	Lake Shore & Mich. So. deb. 4s .		1931	75,000.00	
25,000.00	Wabash Equipment 4½s		1912	24,360.00	
19,000.00	Wabash Equipment 4½s		1916	18,259.00	
50,000.00	Interboro Rapid Transit 5s . . .		1910	48,625.00	1,560,471.86

STOCKS.

Shares.					
172	Boston & Albany R.R.	par	100	34,456.50	
80	Chi., Milwaukee & St. Paul R.R. Pf.	"	100	5,738.00	
12	Cocheco Manufacturing Co.	"	500	6,000.00	
56	Hamilton Woolen Co.	"	100	5,390.00	
31	Great Falls Manufacturing Co.	"	100	3,472.00	
2	Dwight Manufacturing Co.	"	500	1,600.00	
17	Pepperell Manufacturing Co.	"	100	2,789.50	
27	Essex Co.	"	50	3,780.00	
64	Boston Real Estate Trust	"	1000	68,605.64	
1	Boston Ground Rent Trust	"	1000	900.00	132,731.64

INVESTMENT OF THE JOY SCHOLARSHIP FUND.

Massachusetts Hospital Life Insurance Co. . . .		5,000.00	
Deposits in Savings Banks		5,933.77	10,933.77

INVESTMENT SWETT SCHOLARSHIP FUND.

Massachusetts Hospital Life Insurance Co.			10,000.00

INVESTMENT OF RUSSEL FELLOWSHIP FUND.

2,000.00	Conveyancers Title Ins. Co. Mortgage 4s		1908		2,000.00

INVESTMENT WALKER MEMORIAL FUND.

30,000.00	American Tel. & Tel. Co. 4s . .		1929	30,300.00	
54,000.00	N.Y. Central & H. R. L. S. 3½s .		1998	47,986.35	
1,000.00	Chi., Bur. & Quincy R.R. 5s . .		1913	1,055.00	
14,000.00	Oregon Short Line 5s		1946	16,310.00	
5,000.00	St. Louis Iron Mountain 4s . . .		1933	4,812.50	
7,000.00	Wabash Equipment 4½s		1916	6,764.45	107,228.30
Amount carried up					$2,073,409.57

Amount brought up			$2,073,409.57

REAL ESTATE.

Rogers Building		200,000.00	
Walker "		150,000.00	
Land on Garrison Street	50,840.00		
Mechanic Arts Building	30,000.00	80,840.00	
Land on Trinity Place	76,315.69		
Engineering Bldg. A, Trinity Place	90,000.00	166,315.69	
Gymnasium Building		12,624.07	
Engineering Building, B		57,857.10	
Engineering Building, C		47,561.08	
Lot No. 2, Trinity Place		137,241.60	
Lot No. 3, " "		282,286.35	
Henry L. Pierce Building, Trinity Place		154,297.05	
Boiler and Power House, " "		26,916.74	
Clarendon St. Land and Building		142,762.94	
Real Estate, Massachusetts Ave., Cambridge		16,154.38	
Real Estate, Brookline, Mass.		112,964.32	
Aug. Lowell Lab. Elec. Eng. Bldg., 1902		121,790.93	1,709,612.25
Equipment, Engineering Building		16,555.24	
" Mechanical Laboratories		20,628.56	
" Elec. Eng. Building		87,282.24	124,466.04

SUNDRIES.

Notes Receivable	12,450.00	
Loans to Copley Society of Boston	5,666.66	
Students' Notes	570.50	
Physico-Chem. Research Fund	1,056.64	
Cash balance, Sept. 30, 1907	29,898.22	49,642.02
		$3,957,129.88

The foregoing property represents the following Funds and Balances, and is answerable for the same.

The income of the following is used for the general purposes of the Institute:—

William Barton Rogers Memorial Fund	250,225.00	
Richard Perkins Fund	50,000.00	
George Bucknam Dorr Fund	49,573.47	
Martha Ann Edwards "	30,000.00	
Nathaniel C. Nash "	10,000.00	
Sidney Bartlett "	10,000.00	
Robert E. Rogers "	7,680.77	
Albion K. P. Welch "	5,000.00	
Stanton Blake "	5,000.00	
McGregor "	2,500.00	
Katharine B. Lowell "	5,000.00	
Samuel E Sawyer "	4,764.40	
John W. and Belinda L. Randall Fund	83,452.36	
James Fund	163,654.21	
George Robert Armstrong Fund	5,000.00	
Arthur T. Lyman Fund	5,000.00	
Charles Choate Fund	25,000.00	
Nathaniel Thayer Fund	25,000.00	
Alexander S. Wheeler Fund	5,000.00	741,850.21
Amount carried up		$741,850.21

Amount brought up		$741,850.21
The income of the following is used towards paying salaries:—		
Nathaniel Thayer, for Professorship of Physics	25,000.00	
Jas. Hayward, for Professorship of Engineering,	18,800.00	
William P. Mason, " " Geology	18,800.00	
Henry B. Rogers, for general salaries	25,000.00	
George A. Gardner, " "	20,000.00	
Sarah H. Forbes, salaries	500.00	108,100.00
SCHOLARSHIP TRUSTS.		
Richard Perkins Fund	53,434.07	
James Savage "	14,295.78	
Susan H. Swett "	10,582.95	
William Barton Rogers Fund	11,735.40	
Joy Fund	11,133.77	
Elisha Thatcher Loring Fund	5,433.45	
Charles Lewis Flint "	5,334.14	
Thomas Sherwin "	5,050.00	
Farnsworth "	5,000.00	
James H. Mirrlees "	2,899.42	
William F. Huntington "	5,274.13	
T. Sterry Hunt "	3,251.92	
Elisha Atkins "	5,000.00	
Nichols "	5,000.00	
Ann White Vose "	60,946.74	
Ann White Dickinson "	40,809.27	
Dalton Grad. Chemical "	5,499.39	
Willard B. Perkins "	7,483.89	
Billings Student "	50,000.00	
Henry Saltonstall "	10,000.00	
Isaac W. Danforth "	5,640.64	
Charles C. Nichols "	5,424.32	
Richard Lee Russel "	2,249.97	
Lucius Clapp "	5,299.84	336,779.09
OTHER TRUSTS.		
Charlotte Billings Richardson Ind. Chem. Fund,	37,378.78	
Susan Upham Fund	1,310.27	
Susan E. Dorr "	19,288.48	
William Hall Kerr Library Fund	2,000.00	
Charles Lewis Flint " "	5,000.00	
Rotch Architectural " "	5,000.00	
Rotch Architectural Fund	25,000.00	
Rotch Prize "	5,200.00	
Rotch "Special" Prize Fund	5,200.00	
Edward Austin "	379,601.72	
Teachers' "	110,520.00	
Saltonstall "	42,671.00	
Ednah Dow Cheney "	14,058.84	
Letter Box "	81.50	652,310.59
Walker Memorial Fund		112,033.40
Aug. Lowell Lab. Electrical Eng. Fund		68,000.00
George B. Upton Legacy, 1905		5,000.00
Macy S. Pope Legacy, 1906		25,028.81
Thomas Gaffield Legacy, 1906		2,043.18
Charles Merriam Legacy, 1907		25,000.00
M. I. T. Stock Account		1,816,023.15
Amount carried up		$3,892,168.43

Amount brought up		$3,892,168.43
MISCELLANEOUS.		
Cabot Medal Fund	100.92	
Reserve of Income Fund Committee	10,000.00	
Roentgen-Ray Experiment Fund	956.50	
Sanitary Research Laboratory Fund	1,341.05	
Dormitory Fund	1,868.96	
Naval Architecture Fund	189.08	
Students' Fees received in advance	19,685.00	
Deposits for Breakages and Supplies	1,317.81	
Deposits for Breakages and Supplies received in advance	1,070.00	
Accounts Payable	5,397.38	
State Fees received in advance	4,000.00	
Notes Payable	19,034.75	64,961.45
		$3,957,129.88

COMPARATIVE STATEMENT OF FUNDS, ETC.

	Sept. 29, 1906.	Sept. 30, 1907.
Trusts for general purposes	736,850.21	741,850.21
" " Salaries	108,100.00	108,100.00
" " Scholarships	335,390.68	336,779.09
Other Trusts, per page 9	647,063.99	652,310.59
M. I. T. Stock Account	1,821,924.71	1,816,023.15
Walker Memorial Fund		112,033.40
Aug. Lowell Lab. Electrical Eng. Fund	68,000.00	68,000.00
George B. Upton Legacy	5,000.00	5,000.00
Macy S. Pope Legacy	25,000.00	25,028.81
Thomas Gaffield Legacy	43.18	2,043.18
Charles Merriam Legacy, 1907		25,000.00
Miscellaneous, per page 10	141,427.55	64,961.45
	$3,888,800.32	3,957,129.88

Increase,		
Consisting of:		
Bequests for Special Purposes. (See page 14.)	6,611.26	
Gifts and Bequests for General Purposes. (See page 14.)	32,028.81	
	38,640.07	
Less Expenses more than Income	4,902.56	
Less Bond Prem. on Bonds sold 1906	999.00	$32,738.51
Walker Memorial Fund. (Securities on page 7.)		$112,033.40
Decrease in Miscellaneous		76,442.35

INCOME FROM GENERAL INVESTMENTS, AND APPLICATION THEREOF.

Applied to Salaries	4,324.00	From Bonds	68,552.38
" " Scholarships	10,750.00	" Dividends, Railroad Stocks	2,065.00
" " Fellowships	1,400.00	" " Manufacturing Stocks	2,377.00
" " Charlotte B. Richardson Fund	1,495.15	" Real Estate Stocks	2,920 00
" " Teachers' Fund	4,000.00		
" " Edward Austin Fund	14,400.00		
" " Rotch Prize Funds	400.00		
" " Rotch Architectural Fund	1,000.00		
" " Cheney Fund	570.00		
" " Library	480.00		
" " General Purposes	31,350.33		
" " Samuel Dorr Annuity	1,000.00		
" " Increase of Funds	893.40		
" " Advances to Bond Premiums	3,851.50		
	$75,914.38		$75,914.38

INCOME FROM WILLIAM BARTON ROGERS MEMORIAL FUND, AND APPLICATION THEREOF.

Paid Massachusetts Institute of Technology	10,850.50	Received Income from Railroad Bonds	11,492.00
Credited to Advances Bond Premiums	641.50		
	$11,492.00		$11,492.00

DETAILS OF SOME ITEMS IN TREASURER'S CASH ACCOUNT.

Rents.

Huntington Hall, for Lowell Lectures	3,500.00	
Land and Building, Clarendon St., on account	8,500.00	
Use of Rooms and Gymnasium	136.00	$12,136.00
Less Cambridge Real Estate Expenses	71.79	
Less Edge Hill Road Estate Expenses	750.41	
Less Lunch Room Expenses	231.78	1,053.98
		$11,082.02

Department Supplies and Repairs.

Applied Mechanics	1,390.87	
Architecture	1,598.15	
Biology	1,229.75	
Chemistry	14,501.78	
Civil Engineering	1,984.42	
Drawing	913.39	
Economics	419.31	
Electrical Engineering	7,142.66	
English	199.96	
General Library	2,302.10	
Geology	1,308.73	
Heat Measurement	232.18	
History	749.88	
Mathematics	583.39	
Mechanic Arts	3,447.64	
Mechanical Engineering	4,717.06	
Military	612.63	
Mining	3,634.82	
Modern Languages	447.78	
Naval Architecture	830.84	
Physical Culture	1,007.34	
Physics	5,361.76	$54,616.44

Salaries.

Instruction	300,847.32	
Administration	38,218.62	
Labor	44,415.34	$383,481.28

General Expense

Architectural Annual			$1,000.00
Alumni Association			1,000.00
Window Shades			66.00
Furniture			730.67
Stationery and Office Supplies			2,209.72
Postage			1,776.48
Sundries			3,008.57
Express			225.11
Janitor's Supplies			2,287.47
Examinations			470.00
Diplomas and Commissions			577.98
Washing			866.86
Telephone Service, Installing Stations, Rentals, Repairs, etc.			1,496.00
Engine Room Supplies:			
Oil	80.95		
Waste	103.51		
Sundries	105.14		289.60
Ice			400.00
Graduation Exercises			270.55
Removing Ashes			350.40
Glass			40.09
N. E. Trust Co. Deposit Vaults			75.00
State St. Trust Co. Deposit Vaults			75.00
Taxes, Brookline, etc.			471.87 $17,915.03

Repairs to Buildings.

Rogers Building	1,815.41	
Walker "	705.25	
Engineering Buildings, A and B	554.07	
Pierce Building	340.55	
Engineering Building, C	149.23	
Lowell Building	1,002.82	
Gymnasium Building	69.06	
Mechanical Laboratories	255.17	
Boiler and Power House	811.55	
Sundries	186.84	$5,816.55

SECURITIES SOLD OR PAID, GENERAL FUND.

$1,000 Chi., Bur. & Quincy 4s	1922	$1,000.00
1,000 New Eng. Tel. & Tel. 6s	1907	1,000.00
13,000 K. C., St. Jo. & Council Bluffs 7s	1907	13,000.00
2,000 Ozark Equipment 5s	1910	2,000.00
20,000 American Tel. & Tel. Notes 5s	1907	20,000.00
80 Rights Chi., Mil. & St. Paul		2,740.00
5,000 Wabash Equipment Notes 4½s	1907	5,000.00
		$44,740.00

SECURITIES BOUGHT OR RECEIVED AS LEGACIES, GENERAL FUND.

33,000 American Tel. & Tel. Notes 5s	1910	$31,968.75
19,000 Wabash Equipment 4½s	1916	18,259.00
50,000 Interboro Rapid Transit 5s	1910	48,625.00
Interest on Savings Bank Joy Fund deposited		587.46
		$99,440.21

GIFTS AND BEQUESTS FOR SPECIAL PURPOSES.

Sarah E. Dorr Fund, additional	$440.40
Income Scholarship Funds	1,805.86
" Austin Fund	2,715.00
" Teachers' Fund	1,650.00
	$6,611.26

GIFTS AND BEQUESTS FOR GENERAL PURPOSES.

Alexander S. Wheeler Fund	$5,000.00
Charles Merriam Legacy	25,000.00
Thomas Gaffield Legacy, additional	2,000.00
Macy S. Pope Legacy, additional	28.81
	$32,028.81

Boston, Dec. 6, 1907.

Mr. Edward L. Parker, a public accountant, employed by this committee, has examined the accounts of the Treasurer of the Massachusetts Institute of Technology for the year ended September 30, 1907, and has verified the Students' Notes and the cash at office and in banks, and his report is herein annexed.

We have verified the list of securities held by the Institute.

CHARLES C. JACKSON, }
JAMES P. TOLMAN, } *Auditing Committee.*
WILLIAM L. PUTNAM, }

Boston, Dec. 6, 1907.

To the Auditing Committee of the
Massachusetts Institute of Technology:

GENTLEMEN,—I have audited the accounts of Mr. George Wigglesworth, Treasurer, for the year ended September 30, 1907.

They are correct, payments duly vouched, and the receipts from students' fees and all other income duly accounted for. The cash at office and in banks, according to the deposit books, is correct, and the Students' Notes are on hand. The account of property held by the Institute and the funds, and balances, as shown in the Treasurer's report of September 30, 1907, is in accordance with the books.

Respectfully submitted,

EDWARD L. PARKER,
Public Accountant.

Volume 44 Number 2

BULLETIN

OF THE

Massachusetts Institute of Technology

BOSTON

REPORTS

OF THE

PRESIDENT AND TREASURER

PRESENTED AT THE DECEMBER MEETING OF THE CORPORATION

JANUARY, 1909

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Report of the Acting President.

To the Members of the Corporation:

I have the honor to present to you to-day a report upon the progress of the Institute during the past year and upon its condition at the present time. In the report made last year I had the privilege of placing before you my views as to the educational policy which the Institute should follow and as to the most important problems of development. I shall try to show you what degree of progress has been made in the solution of these problems, and shall bring to your attention certain other matters which seem to deserve especial consideration.

CHANGES IN THE CORPORATION AND FACULTY.

The most important event connected with the membership of the Corporation and Faculty is, of course, the recent election of Professor Richard C. Maclaurin, now of Columbia University, to the Presidency of the Institute. By this appointment, this institution is to be placed under the leadership of a man of the highest personal qualities, of an eminent scholar distinguished in two of the most fundamental branches of science taught at the Institute, and of an experienced educator acquainted with the systems of higher education prevailing all over the world and highly sympathetic with our own. Under his guidance, aided as he will be by the most cordial co-operation of Corporation, Faculty, Students, and Alumni, we may rest assured that the Institute is about to enter upon a new epoch in its history, to be characterized by an unexampled development in all directions, carried out upon sound principles.

The Corporation has welcomed to its membership three new

term members, elected from among the nominees of the Alumni Association—Messrs. Arthur T. Bradlee, Everett Morss, and James W. Rollins, Jr., all of Boston. Through this election the number of term members attains the maximum of fifteen provided for by the by-laws of the Corporation.

It is with great regret that I have to recall that during the past year the Corporation has suffered the loss of one of its life members, Mr. Charles L. Lovering, who has been a member of this body since 1896. A memorial of his life, prepared by a colleague on this board who was well acquainted with his work, was published in a recent number of the *Technology Review*, which was sent to all members of the Corporation.

During the past year there have been, I am glad to say, no changes in the Faculty brought about through resignation or death. Its membership has, moreover, been increased by the promotion to the grade of Assistant Professor of eight members of the Institute staff, whose successful work as instructors has shown them to be well worthy of this honorable recognition. These newly appointed members are: Charles W. Berry, Assistant Professor of Mechanical Engineering; Arthur A. Blanchard, Assistant Professor of Inorganic Chemistry; Harry C. Bradley, Assistant Professor of Drawing and Descriptive Geometry; Harrison W. Hayward, Assistant Professor of Applied Mechanics; Ervin Kenison, Assistant Professor of Drawing and Descriptive Geometry; Joseph C. Riley, Assistant Professor of Mechanical Engineering; Hervey W. Shimer, Assistant Professor of Paleontology; and Alpheus G. Woodman, Assistant Professor of Food Analysis. Dr. Gilbert N. Lewis, who during the past year has acted as Director of the Research Laboratory of Physical Chemistry, has been advanced to the grade of Associate Professor of Physico-Chemical Research.

Upon Professor Robert H. Richards, the degree of Doctor of Laws has been conferred by the University of Missouri, in recognition of the distinguished services rendered by him in promoting the science and practice of mining engineering. A similar honor was conferred upon Professor George F. Swain

a little more than a year ago by the University of New York, in recognition of his expert knowledge and high accomplishment in the field of civil engineering.

FACULTY AND DEPARTMENT ORGANIZATION.

By the new appointments just referred to, the Faculty becomes a body of ninety-two members. In spite of its large size, its work is carried on effectively through the agency of a large number of Standing Committees. The character of this organization and its satisfactory working were described in my former report. Improvements in it are, nevertheless, frequently discussed by the Faculty. At the present time there is an especially important question of this kind under consideration by the Committee on Faculty Business—that of appointing a new standing committee of the Faculty on each of the thirteen Courses of Study, to take the initiative in recommending changes in the curriculum of the Course. This initiative has previously rested almost wholly within the single department most closely associated with the Course; but the composite character of our Courses seems to make desirable the closer participation of several departments in the matter; thus, to cite a rather extreme example, the Course in Mining Engineering and Metallurgy includes, in not very far from equal proportions, studies in these two subjects, in Chemistry, in Geology, and in Mechanical Engineering; and a well-balanced course-schedule can probably be best worked out through the joint co-operation of all the departments concerned. The same is true in greater or less degree of almost all our other courses. Another important result that might be secured by this plan is a larger influence and participation in Faculty and Departmental affairs of professors who are not in charge of departments.

This last consideration is one of great importance not only because of the direct value of the advice and opinions of these men, but also because it is essential to give to them positions of as much influence and responsibility as possible, if teachers

and scientists of the first rank are to be secured and retained in our departments. To this end and also for the purpose of increasing the efficiency of our administrative system, I believe it is desirable that the formal organization of our departments —at any rate of the larger and more composite ones—be carried one step further and that there be definitely appointed, upon recommendation of the professor in charge of the department, other professors to take charge of the larger branches of instruction; for example, within the Department of Civil Engineering individual professors might be placed in charge of the instruction in structural, hydraulic, railway, and topographical engineering, respectively. As their titles would indicate, such men should deal with the distinctly educational aspects of the work of instruction intrusted to them, and should be held personally responsible for its success. To make such responsibility effective, they should be given the privilege of submitting to the President and Executive Committee, through the professor in charge of the department, recommendations as to the promotion and salaries of their own subordinates.

It is also, I believe, desirable that there be established a more definite system of promotion and salary payments applicable to all the departments of the Institute. This seems important from many points of view—as an aid to the President and Heads of Departments in deciding many vexatious personal questions, as a means of securing uniformity of treatment throughout the Institute, and as an aid in improving the character of our staff.

THE REGISTRATION OF STUDENTS.

The number of students now registered at the Institute is 1,461, an increase of 51 over the number attending at the same time last year. This is mainly accounted for by the fact that the first-year class contains 57 more students than it did a year ago, while the three higher classes, taken together, include about the same number of students as last year.

This large increase again raises the much discussed question whether a limitation should be placed upon the number of our students. Upon this matter my own opinion is that it should be the permanent policy of the Institute to receive and provide for all those capable and well-prepared students who desire to avail themselves of the opportunities it offers; for only in this way can it attain its full measure of usefulness. It should not be deterred by the educational difficulties involved in the instruction of large numbers of students. The Institute is already a large school; and, if it continues to hold the first place among institutions of its kind, it will inevitably become still larger: for it is not justifiable to raise the standard to the point of demanding extraordinary scholarly attainment, since other qualities than scholarship play an important part in determining the success of a professional or scientific career. The Faculty and staff of instruction must therefore face resolutely the problem of teaching large classes effectively; administrative officers must see that the character and organization of the staff is such as is adapted to this end; and the Corporation and Alumni must aim to secure the resources which will provide sufficient facilities in the way of class-rooms, laboratories, and equipment, and will make possible the payment of adequate salaries, such as will retain efficient teachers.

This last factor—the financial resources of the institution—is, however, the crucial one in deciding at any given time the question of numbers. While I have expressed the opinion that, looking to the future, our general policy should be to provide for any natural growth of the institution, I wish to emphasize even more strongly the idea that, for the present, until additional accommodations have been provided and until increased funds for this purpose and for the current expenses have been secured, it would be a serious mistake to permit the number of students to increase much beyond the present registration; for it would mean that the effectiveness of our teaching would be much impaired. The quality of our work is the first consideration; and the quantity of it must be increased,

whether through growth in the size of our classes or through provision for new lines of instruction, only when the funds available are sufficient to enable it to be done without detriment to the work already in progress. Regrettable as it may be from some points of view, it is therefore, I believe, imperative that the Faculty take measures to prevent any further increase in the number of first and second-year students, through a more rigorous enforcement of scholarship requirements.

The number of new students who have previously attended other colleges has again shown a substantial increase—from 155 last year to 170 this year. Of these students 16 per cent. enter the first year, 28 per cent. the second year, 46 per cent. the third year, and 9 per cent. the fourth year of our undergraduate courses. Of the 230 candidates who received the degree of Bachelor of Science last June, 18 per cent. had previously graduated at some other college, and 14 per cent. more had attended some other college for one or more years.

There is also a notable increase (from 20 last year to 29 this year) in the number of students pursuing advanced work for the degrees of Master of Science, Doctor of Philosophy, and Doctor of Engineering.

The proportion of Massachusetts students (57.5 per cent.) has somewhat increased over that of last year (55.5 per cent.).

Other interesting statistical information will be found in the report of the Registrar.

DEVELOPMENTS IN THE WORK OF INSTRUCTION.

Advanced Courses of Study.

From the standpoint of our general system of instruction the two most important developments of the past year have been the much fuller provision made for advanced courses of study leading to the higher degrees of Master of Science, Doctor of Philosophy, and Doctor of Engineering, and the more definite organization of five-year undergraduate courses leading to the Bachelor's degree. The former courses have

been developed by the Faculty along the lines referred to in my last report; and a Bulletin entitled "Advanced Study and Research" has been issued by the Institute, in which these courses are fully described. As this Bulletin has been sent to members of the Corporation, I shall not discuss these advanced courses further.

Five-Year Courses leading to the Degree of Bachelor of Science.

I wish, however, to call your attention to the new five-year undergraduate courses which have been arranged for. The Faculty has taken this action, in order that students who can afford to spend an additional year may realize that it is highly important to do so, if they wish to secure in full measure the advantages of the combination of liberal education, scientific training, and professional knowledge which the Institute offers.

These courses are of three types. In one of these the student supplements all the required work of one of the regular four-year courses with the equivalent of an extra year of study in language, literature, fine arts, history, economics, and in the fundamental sciences of chemistry, physics, astronomy, geology, and biology. These additional general studies are entirely elective. This plan of study thus provides in large measure for the breadth of scholarship which a college course is designed to supply; but it does this by the methods and in the atmosphere of the scientific school and with special emphasis upon general scientific studies as a part of a liberal education. Upon students who complete such a course is conferred the degree of Bachelor of Science in two departments of study, namely, in General Science, and in that branch of engineering in which the professional work has been completed.

The range of such elective studies of a liberal character which the Institute offers to its students is an extended one; and only in one direction does this side of our work seem to need strengthening. We have, unfortunately, no courses of lectures on philosophy, psychology, and ethics; and I would

submitted, much better results would, I am sure, be obtained by placing each instructor in full charge of a limited number of students, say sixty or eighty, and having him, with the aid of an assistant when necessary, carry on with those students all the different sides of the work in the subject in question (except the course of experimental lectures, which it is especially uneconomical to repeat). He would thus not only get much more closely acquainted with his students and come to understand their individual difficulties, but he would feel a personal responsibility and pride in the success of those intrusted to him. He has, moreover, a greater variety of work, and avoids the monotony of an undue number of repetitions of the same exercise with a large number of sections. Professor A. E. Burton has called attention in his report submitted herewith upon the Department of Drawing and Descriptive Geometry to the importance of making such a change in the method of instruction in these subjects; and it would, I believe, be equally advantageous in such subjects as chemistry and physics, in which the instruction consists of a combination of lecture, recitation, laboratory, and problem work. The present method of giving such instruction to large classes has grown up in the larger colleges as a result of an assumed need of economy in this direction; for there is some economy of effort in the division of labor between the different sides of a teacher's work, and there is a large economy in the average salary paid when one professor is employed to supervise and to give the lectures, and inexperienced or otherwise inefficient instructors and assistants are engaged to do the real teaching. From an educational point of view, however, the method is unsatisfactory; and, until it is abandoned, the problem of handling large classes will not be adequately solved, and large colleges will be at a disadvantage in comparison with small ones. Moreover, though the other plan of individual responsibility does involve additional expense, the amount required is not inordinate; for the main work of instruction might well be done by men of intermediate grades receiving

(according to their length of service) from $1,000 to $1,800 a year; and it would, I believe, be better to curtail expenditure in almost any other direction than in this one, which is so essential to the efficiency of the teaching of our fundamental subjects.

Requirement of Summer Work.

In my previous report I called attention to the important advantages which would result from the transfer to a summer period of some of the required work in the field, laboratory, and drawing-room, as well as to some of the difficulties involved. A committee of the Faculty has studied this matter, and has prepared for the consideration of the Faculty a plan providing for the requirement of three and one-half weeks of work in the month of June by all students between their first and second years. The work included in this summer period would consist of surveying in all those courses of study which have this subject, of mechanic arts and descriptive geometry in certain other courses, and of chemical laboratory in certain others. The time set free in the school year it is proposed to utilize for the introduction, not of any new subjects, but of additional recitations and preparation time into the general courses in chemistry, physics, and English composition, literature, and history. For the transfer of surveying to the summer there are strong reasons of a special character which have been fully set forth by Professor Swain in his reports upon the Department of Civil and Sanitary Engineering both this year and in previous years. Professor Swain submits in this year's report a detailed plan for a surveying summer camp, to which I would call your attention.

New Subjects of Instruction.

A few important subjects of instruction are offered to undergraduates as new optional studies for the first time this year. A series of informal talks upon German life and institutions is being given in the German language by Dr. Hermann Schu-

macher, who has come to the Institute this term from the Royal Gymnasium of Cologne under the auspices of the Carnegie Foundation for the Advancement of Teaching. A course of lectures on Cosmic Physics, presenting the broad aspects of this subject and the recent advances in it, is to be given to our students through the kindness of Professor Percival Lowell. During the present year the instruction in Economic Geology has been placed under the charge of Dr. Waldemar Lindgren, an eminent expert in that subject from the United States Geological Survey. A new Option upon the subject of Steam Turbine Engineering has been introduced into the Course of Mechanical Engineering upon the initiative and under the direction of Professor C. H. Peabody. In addition, new courses for advanced students are offered in many of the departments.

A New Research Laboratory.

Through the liberality of a member of the Corporation it has been possible to make definite provision for the important extension of our advanced instruction and research work to the industrial applications of chemistry. By the establishment at the beginning of this year of the new Research Laboratory of Applied Chemistry as a division of the Chemical Department special opportunities are afforded for the execution, by salaried research assistants and by advanced students of investigations of chemical problems of interest to the manufacturer. In a report submitted herewith, the Director of the Laboratory, Professor William H. Walker, describes the work which is already in progress.

DEVELOPMENT OF THE BUILDINGS AND EQUIPMENT.

Some important additions have been made during the past summer to our laboratories and equipment.

Greatly needed space has been provided for the Laboratory of Steam Engineering by extending it into the old lunch room in the Pierce Building; and there has been installed in

it a 500-kilowatt steam turbine, together with a condenser, pumps, and other accessories.

In the boiler and power plant there have been installed two new boilers, furnished at a greatly reduced price by the Babcock and Wilcox Boiler Company, for which assistance the Institute wishes to express its great indebtedness. The whole plant has, moreover, been rearranged and modernized under the direction of Professor E. F. Miller; and it is largely in consequence of his experience, good judgment, and devotion to the undertaking that the Institute now possesses a model plant, which will serve not merely to furnish heat, light, and power to its buildings, but will enable its students to study in a more practical way the problems of steam engineering.

Additional room has also been assigned to the Laboratory of Analytical Chemistry, to enable the Department of Chemistry to provide for the increased number of students pursuing its subjects in the higher years.

A very valuable addition has been made to the instrumental equipment of the Department of Geology. A modern seismograph of the most improved form, purchased with the aid of a gift from the estate of Caroline A. R. Whitney, has just been received by the Department. It is hoped that provision can soon be made for setting it up in a suitable location in the suburbs, remote from the shocks of the city.

The Department of Economics has received an important addition to its equipment through the generous gift to the Institute of the private library of General Francis A. Walker, by his widow, Mrs. Exene Walker. This library consists of about 1,500 volumes on economics, many of which are very rare and valuable. In appreciation of this gift and in further recognition of the distinguished services of our former president to this institution and to this branch of science, the Executive Committee has voted that the name Francis A. Walker Library of Economics be attached to the whole collection of works upon this subject possessed by the Institute.

In speaking of our buildings and equipment, I must not

fail to emphasize the seriously crowded condition of our present quarters, even though it be a time-worn topic of college presidents. I wish specifically to call your attention to the following facts: our limited space makes impossible any increase in the number of our students; it prevents development of our present work in any new direction, however desirable it may be; it prevents, through lack of class-rooms, an extension of the plan of instruction in small sections, which as I have stated is so essential to efficient teaching; it involves (most strikingly in the case of the Chemical Department) a separation of different divisions of the departments, thus hindering a close association of the different instructors and proper correlation of their work; it makes necessary a crowding of students and apparatus in our laboratories which makes thoughtful and reliable work difficult; and it gives no opportunity for providing our instructing staff with adequate offices and private laboratories in which writing, calculations, and investigations can be properly carried on.

Though the physical condition of the Institute is, as I have indicated, one that makes impossible further growth or a development of its work in new directions, and one that does in some measure impair the efficiency of our present instruction, yet I should be sorry to give you the impression that the latter effect is of a very serious character. On the contrary, there has, I believe, never been a time when our teaching was so thorough or our system of education so generally effective; and this results from the fact that limitation of space is, after all, only a secondary factor in the whole problem. Equipment for lecture and laboratory work is another physical factor of at least equal significance; and on this side the Institute, taken as a whole, is extraordinarily well provided for. Far more important than either of these are, moreover, the character of the teacher, the spirit of the student, the methods of instruction, and the standards of scholarship and ideals of the institution; and in all these respects the Institute is steadily advancing.

Nevertheless, while recognizing the more vital importance of these considerations, we must not permit our growth and development to be hampered by inadequate accommodations and unsuitable physical surroundings. The situation is, moreover, one that requires radical treatment; for the condition referred to prevails throughout the whole Institute, and not merely in a few departments. In this respect our position is different from that of those universities which have developed upon the plan of making ample and permanent provision for one department every few years, instead of making during the same period such provision as might be possible for all departments of the institution. Since time is a highly important factor in determining the growth and reputation of institutions and the value of the service which they render, I believe the plan of continuous all-sided development which we have followed was the wisest; but it should be realized that we are now facing the logical result of that plan, which has made it imperative that the whole Institute be now rebuilt upon a permanent basis and upon a new site better adapted to its needs. Though no definite action in this direction has been taken by your body or by the Committee on the Site which you have appointed, yet I believe that, during the past year, through informal discussion and individual consideration of the matter, there has grown up not only among your own members, but among all the other groups of men connected with the Institute,—Faculty, Alumni, and Undergraduates,—a sentiment so strong that it will be satisfied with nothing less than the creation of a new Institute on a new site. It has also, I believe, come to be recognized that the securing by private subscription of a moderate sum of money is an essential preliminary to the serious discussion of any plan of rebuilding and removal. This feeling was expressed by the action taken at the last stated meeting of the Corporation requesting the Committee on the Site to act also as a committee for obtaining funds for the development of the Institute. In my own opinion, this is not a matter that should be left to the initiative of the President or of other

individuals. It can be adequately accomplished only through a well-organized effort carried on jointly by representatives of the Corporation and the Alumni.

DEVELOPMENTS IN THE CONDITIONS OF STUDENT LIFE.

Through the opening of the new Technology Union in the building erected on Trinity Place during the past summer, a most important step has been taken in the development of the social life of our students.

The new Union was made possible mainly through the interest and efforts of the Committee on the Welfare of Students appointed by the Corporation last March, and through the generous donations of individual members of this body, which provided for a large part of the expense involved. That this assistance is highly appreciated by the students is shown by the following resolution, which I present to you with much pleasure at the request of the Institute Committee, which is a large committee thoroughly representative of the whole student-body:—

Whereas a new and magnificent Union has been provided for the use of the students of the Massachusetts Institute of Technology largely through the efforts of the Committee on Student Welfare of the Corporation and through the gifts of members of the Corporation and Alumni.

And whereas the management of this Union has been largely vested in the hands of the students, be it

Resolved by the student-body of this institution that their heartfelt gratitude be extended to the said Committee and all others through whose generosity this important development of student life has been made possible; and be it also

Resolved that the students by their use of the Union will at all times demonstrate this appreciation; and be it further

Resolved that a copy of these resolutions be sent to the members of the Committee on Student Welfare of the Corporation and to all other members of the Corporation and Alumni who have contributed funds for the erection and equipment of the Union.

The Union serves the purposes both of a club house and of a general eating place for students. On the first floor there

is a large dining-room, in which students who desire to do so may get all their meals, both week-days and Sundays, the kitchen being in the adjoining basement of the Pierce Building. On the second floor, there is a smaller dining-room available for the meeting of student societies; and a large social or living room, where students may gather in their spare time for reading and conversation and where evening entertainments may be held; also a small room known as the quiet room. In the mezzanine part, a coat room and students' post-office, a lavatory, and three small rooms for offices for student organizations are provided. In an adjoining room is the office of *The Tech*, the students' newspaper.

The control of the Union has been placed in charge of a committee of nine members, of whom a majority are undergraduate students elected by the Institute Committee. There have also been elected by the students three sub-committees to take charge of different sides of the Union's activities, namely a House Committee, a Dining Room Committee, and an Entertainment Committee. The latter of these committees has arranged for the holding of popular lectures or musical or other entertainments regularly on every Friday evening.

The admirable spirit of our students, manifested not only in connection with this Union, but in many other ways, is, I believe, one which can be matched at few, if any, other colleges. I cannot refrain from mentioning to you a striking illustration of this. The Institute Committee has recently recommended, and the student-body has put into practice, a plan known as the "point-system," which has been introduced in only one or two other colleges. The purpose of this plan is to restrict the number of different offices in the various student organizations which one individual may hold. To each office a certain number of "points" is attached, and no student can hold positions corresponding to more than a specified maximum of points. This rule hinders a few aggressive individuals from monopolizing the direction of student-activities, whereby their own scholarship is sacrificed and the desir-

able participation in more moderate measure of a larger number of students is prevented.

THE DEVELOPMENT OF CLOSER RELATIONS.

In order to enable the Institute to fulfil more effectively its educational mission, a determined effort must be made to establish closer relations with and among the different organizations and groups of individuals that are in any way associated with the work of the Institute. While its success will, of course, depend primarily upon the character of the education it affords and upon the contributions to scientific progress it makes, yet no institution of learning, and least of all a school of applied science, can afford to neglect the cultivation of such relations. I believe that insufficient attention to this matter during the past ten years has been a serious obstacle in the way of our progress, and that there is no more important task before us in the immediate future than that of remedying this defect.

Relations among the Groups within the Institute.

First of all, there should be close co-operation among the different groups within the Institute itself, this Corporation, its Executive and other Committees, the Alumni, the Faculty and instructors, and the undergraduates. There should be full discussion of new questions as they arise, not merely by the body which may have the final decision, but by all others who have any natural interest in them. The carrying on of an educational institution is in its very essence a co-operative undertaking; and full publicity and free discussion of its affairs is one of the prime conditions of its success.

As suggested in my previous report, members of this Corporation can, I believe, render great assistance to the Institute through a more direct participation in its work. This may be done in the case of such matters as specific improvements in the courses and methods of instruction, in the con-

ditions of student life, in the equipment of the departments—in the case of any special matter in which a member may take a personal interest—through individual co-operation with the President, Dean, and professors in charge of departments. For the consideration of larger questions the appointment of special committees seems the best method, members of the Faculty or Alumni who are especially interested in the matter under consideration being invited to attend. The Committee on the Promotion of Welfare of Students appointed by the Corporation at the March meeting has furnished a striking illustration of the effectiveness of this plan. To the interest and activity of that Committee, which had the benefit of the co-operation of the Dean, the Bursar, and representatives of the alumni and student-body, the establishment of the Technology Union is, as I have already stated, largely due.

It is also important that close relations be maintained between the students and the administrative officers and other members of the Faculty, so that the needs and interests of the former may be well understood, their points of view appreciated, and their co-operation in promoting the aims of the Institute secured. Few greater mistakes could be made than that of failing to enlist the direct interest and support of the students in the solution of the general and educational problems which confront us. Such co-operation has been made easier through the reorganization during the past year of the Institute Committee, by which it is made thoroughly representative of the student-body, as well as by the closer contact between students and administrative officers which the Technology Union has brought about. The President and the Dean have also been greatly aided on this side of their work by the appointment made last year by the Executive Committee of Mr. H. A. Rapelye of the class of 1908 to the new position of President's Assistant. His intimate knowledge of our student life has enabled him to advise and assist us effectively in many ways. He has among other things taken an important part in the arrangements connected with the new Technol-

ogy Union, and is now organizing a Student Employment Office, through which this important work may be more effectively handled.

Relations with the Alumni.

The relations of the Alumni to the Institute have during the past ten years grown much closer and more effective; and the present year is to be an especially important one in this respect. There is to be held in Boston next June the Quinquennial Reunion of all Technology Alumni. There is to be issued under the auspices of the Reunion Committee and the Institute the first complete register of former students, including non-graduates as well as graduates, and thus identifying the former more closely with the Institute. The Alumni Association is about to be reorganized through the formation of an Alumni Council of about sixty members so chosen as to be thoroughly representative of the whole body. This Council will form a responsible body whose advice and cooperation may properly be invited by the President and Corporation in connection with many of the problems of development.

For fostering and extending the relations with the former students of the Institute no opportunity should be lost; for upon their feeling towards it depends in large measure its success. Their attitude determines its reputation throughout the country; their influence is directly or indirectly the source of most of its students; their enthusiasm stimulates its officers and professors to greater efforts; and their aid in securing financial support is essential to its development. Our Alumni Association is most active in keeping our former students informed in regard to the Institute, and in maintaining their interest in its welfare; but the Institute authorities must also co-operate in this undertaking. Among other things, the administrative officers or other deputed members of the Corporation and Faculty should visit periodically the various alumni associations throughout the country. Dean Burton has just re-

turned from a trip of this kind to the Pacific Coast, where he took part in the organization of new Technology Clubs in Seattle, Washington, and in Portland, Oregon.

Relations with the Secondary Schools.

The relations of the Institute to the secondary schools deserve constant attention. With those schools the Institute has always kept closely in touch with reference to its entrance requirements, taking care not to make them so excessive as that the brighter pupils from the better high schools cannot meet them without additional preparation, nor so uneven as to distort the curricula of these schools. Any addition to our requirements should, I believe, be of an alternative character, so that they may be adapted to the different preparation afforded by the various types of high schools, which are constantly becoming more diversified. It is, for example, desirable that it be made easier for graduates of classical courses in the high schools to enter the Institute.

But there is another direction in which the relations of the Institute and of other scientific schools to the secondary schools need to be cultivated. Owing to the fact that by far the larger number of teachers in the high schools have received an academic rather than a scientific training, owing to the undue development in this part of the country of the sentiment that a more effective education is secured under the collegiate plan than under that followed by even the best scientific schools, and owing to the failure to appreciate that the social and physical sides of student life are developed at the Institute upon a sounder basis and in better proportioned measure than at most of the colleges,—for these reasons the advantages of our system of education and the opportunities afforded by the scientific professions in general are not sufficiently understood by boys in the preparatory schools nor by their teachers and parents. There is, therefore, a need in this community that the public be better informed in this matter,—not so much because the interests of the Institute are involved, as

because it is important that both types of educational effort be duly appreciated. The Faculty Committee on the Relations with Secondary Schools has under consideration the question of what can be done in this direction. It is to be hoped that individual members of our instructing staff will also avail themselves of any opportunities that occur for the presentation of these considerations to teachers and pupils of the secondary schools. There is, however, no part of the Institute organization which can accomplish so much on this side as our student-body, the individuals of which can readily maintain close relations with the special schools from which they have come.

Relations with the Public.

There are also important relations to be maintained with the general public. The public should be kept informed, through the press and otherwise, of the activities of the Institute; and all those industrial, commercial, and transportation interests which are in any measure dependent on scientific knowledge and investigation should be made to feel that the Institute stands ready to place at their service for the study of their problems the expert advice of its staff and its laboratory facilities. In the further development of those facilities, through the establishment of research laboratories of applied science and of engineering testing stations, and through the installation of the elaborate testing machines and other scientific instruments needed for investigation purposes, the co-operation of the manufacturers of this community should be secured. As an aid to the officers of the Institute in promoting closer affiliations in these and other directions, the Institute has been fortunate in securing the services of Mr. I. W. Litchfield, one of our former students, who has long shown a deep interest in the Institute and an energetic and intelligent devotion to its welfare. Since the beginning of his official connection with the Institute last September, he has taken an important part in the successful starting of the Technology Union, in the development of the Society of Arts, in the

co-ordination of the work of the student press reporters, and in other matters relating to the public sides of the Institute's work and to the activities of the Alumni.

The Society of Arts, the oldest part of our organization, has for its primary function the general dissemination of scientific knowledge, especially with reference to the recent advances and practical applications of the sciences; but it also furnishes incidentally a means of making the work of the Institute known to the public. I am glad to be able to tell you that as a result of the earnest efforts of its Executive Committee, new life has been infused into that Society, and an unusually valuable and attractive program has been arranged for the meetings of the present year.

Relations with the State.

With the State the Institute naturally stands in intimate relations. It bears its name, it is located in its capital city, and it received from it its charter and the plot of ground on which its older buildings are located. Three representatives of the State sit upon its governing board. Forty free scholarships are maintained, available for applicants from the various senatorial districts. Finally, for a number of years financial aid has been received from the Commonwealth. Without sacrificing its national scope or its own independence, the Institute should therefore constantly strive to serve the State in every possible way,—in the development of its natural resources, in the improvement of its industrial processes and its transportation facilities, and especially in the solution of its educational problems. In all these respects, it should stand to the Commonwealth much in the same relation as do the progressive State universities of the middle West. In order that the Institute may render, in a larger measure, this public service, the State should supply the necessary resources. The forms which it would seem such assistance would most naturally take are: first, provision for a reduced tuition to Massachusetts students or increased scholarship funds for their benefit, such as will

place the educational opportunities which the Institute affords within the means of a larger proportion of the well-prepared graduates of the High Schools of the State; second, provision for the execution in its laboratories of investigations in engineering and applied science which are of especial importance to the development of the State's resources and industries; and third, co-operation with the Institute in providing for workmen a sound education in the industrial sciences, by means of evening courses carried on in its class-rooms, drawing-rooms, and laboratories by members of its instructing staff.

CONCLUSION.

It will, of course, be appreciated that, though it is the function of the President to be in touch with all the various organizations and interests that have been mentioned, and though he must often take the lead in extending the relations between them and the Institute, yet he can perform, even with the assistance of the other administrative officers, only a trifling part of all that needs to be done in these directions. In closing this report, I would therefore emphasize, as the watchwords of our future progress, the ideas of *co-operation* and *closer relationships*. If there be also shown the fullest *confidence* in the soundness of our educational system and in its support by the community, its proper growth and development will be assured.

I desire finally to lay before you the reports which have been presented to the President by the other Administrative Officers and by the Professors in Charge of Departments. These will be printed as a part of the President's Report and sent to members of the Corporation.

ARTHUR A. NOYES.

Reports of Administrative Officers.

REPORT OF THE SECRETARY OF THE FACULTY.

The plan proposed by the Committee on Five-Year Undergraduate Courses of publishing definite schedules for such courses has been adopted by the Faculty. This plan provides that the studies of the first year shall be the same as those required of all regular students, and that, beginning with the second year, three methods of continuing the Institute work for four years longer shall be open to students. One method arranges for the distribution of the remaining three years' required work over four years, giving the student an average of 540 hours per term, instead of 720 hours. Definite schedules have been prepared on this basis for the Courses in Civil, Mechanical, and Electrical Engineering. A second method gives the student the opportunity of combining the work of two allied Courses during the remaining four years, and makes it possible for him to receive the degree in two departments of study, in each of which it is required that a thesis be presented. The following combination-courses have been prepared: Civil and Sanitary Engineering, Mechanical and Electrical Engineering, Mechanical and Chemical Engineering, Mechanical Engineering and Naval Architecture, Electrical Engineering and Naval Architecture, Electrical and Chemical Engineering, and Mining Engineering and Geology. The third method is to occupy with additional studies in English, history, and general science, the time gained by the distribution of the required work of the course over five years, thus giving students the opportunity of obtaining a broader general education. Such a com-

bination of professional and general science studies may lead to a degree in General Science in combination with the degree in the professional course pursued.

The standing committees on first and second year students have met six times during the year to scrutinize the intermediate and final records of those students, and have endeavored to ascertain the reasons for the low standing of students having poor records. A similar committee reviews the records of the third year students at the end of each term. Students having low records are referred to the Dean or to some other member of the Faculty for conference and advice before any severe action is taken. During the year, 596 students have been so referred. In January, 1908, 24 students were advised, and 19 required, to withdraw from the Institute, and in June, 48 were advised and 40 required to withdraw; such action having been taken only after repeated conferences and evidence in each case that continuance at the Institute would not be for the best interests of the student. Students who have not obtained satisfactory records during the first year are in general not allowed to continue the full work of the second year, this plan being of assistance in maintaining the high standard of work which the Institute demands, and also discouraging students who are apparently unfitted for the higher work of their chosen Courses from attempting such work until they are thoroughly prepared.

There are at present twenty-nine students at the Institute taking graduate courses, one of these a candidate for the degree of Doctor of Engineering, seven, candidates for that of Doctor of Philosophy, and twenty-one for the Master's degree. Four have been appointed Fellows.

Fellowships and graduate scholarships to the amount of $5,100.00 have been awarded for the current year. One hundred and fifty-four undergraduate students have received scholarship grants from Institute funds, the total amount awarded being $19,100.00.

The number of new students at the Institute who have been admitted on credentials from other colleges is larger than that

of last year, eighty-nine of these being graduates, and eighty-one non-graduates.

In June, 1908, two hundred and forty-four students were awarded the degrees of the Institute,—three receiving that of Doctor of Philosophy, twelve that of Master of Science, and two hundred and twenty-nine that of Bachelor of Science.

ALLYNE L. MERRILL,
Secretary of the Faculty.

REPORT OF THE DEAN.

The work of the Dean's office has been much the same as for last year. Although it has been found that the system of advisers is not of much practical utility after the first few days of the year, when advisers are consulted chiefly in regard to questions of registration, it was decided to continue the system for at least one more year.

The "Conferences" in the English Department and in the Mathematical Department have made it possible to obtain for every first-year student a personal association with some member of the instructing staff, and these instructors are proving to be the best advisers for first-year men. This conference system has been introduced into the course in Physics during the present year, and it is expected that this will be of great benefit to second-year students.

There was some discussion among the members of the Faculty as to the advisability of placing in the hands of the Walker Club the reception which it is desirable to give to students coming to us from other colleges. I think our experience last year showed to us that the reception by the Walker Club had peculiar advantages from its informal character. The men attending it were much more likely to become acquainted with each other than if the reception had taken on the character of a formal presentation to members of the Faculty. I have found, from conversation with many of the men from other colleges

who have attended this reception given by the Walker Club, that it is regarded by them as a very pleasant event, and that to it they were principally indebted for their acquaintance among their fellow students during their first year.

The number of boarding-houses which were included in the list kept in the Dean's office the past year was something like three hundred, and through the kindness of the Secretary of the Student Young Men's Christian Association a better personal inspection of the city houses was made. In the future the room and boarding-house register will be in charge of the President's Assistant.

Great difficulty was experienced last year in securing positions for students during the summer months. This was undoubtedly due to the general inactivity in engineering work and building construction. The usual number of men, however, obtained positions at hotels, and as draftsmen, clerks, chauffeurs, etc. It is intended in the coming year to establish a regular employment office for undergraduates which will also be in the charge of the President's Assistant. It is hoped by this arrangement to actually seek out work for students by means of personal interviews with employers. The number of students applying for summer work was considerably over one hundred.

Many important changes have taken place during the past year in the management of student affairs. The Institute Committee, which has long been intended to represent the student body in treating with the Faculty and Corporation, has been made a much more representative body of men by adding to the members elected directly to the Committee from each class, the presidents of the departmental societies, such as the Civil Engineering and Mechanical Engineering Societies; and the presidents of the musical clubs, the Athletic Association, and the Young Men's Christian Association. The good effect of this change in the personnel of the Institute Committee was manifested at once. An agitation for a better social hall, which was begun by the editors of *The Tech*, the students' newspaper, was carried on by the Institute Committee; and a very effective

report on the need of a social and dining hall was made by the latter body to the Executive Committee of the Corporation. The result of this movement has been the erection of a new building on Trinity Place. This building for a social and dining hall was erected during the summer months, and its management was placed in the hands of a committee of which the Dean is Chairman, and upon which are the Bursar, the editor of *The Technology Review*, the President's Assistant, and five members from the undergraduate students elected by the Institute Committee. As soon as the opening of the term allowed students to begin their work upon this Committee, arrangements were made to transfer the real responsibility to the undergraduates; and now the Union is a building open to all Institute students, and is practically under the management of undergraduate committees with a senior as chairman of each.

In accordance with a vote of the Faculty, students in the first year were required to take a physical examination. This examination resulted in the pointing out rather forcibly of the need of systematic physical training for the great majority of our men. As it was the men who most needed physical exercise who would not seek the gymnasium while such training was optional, it was decided by the Faculty that this year some sort of physical training should be made compulsory and the Dean was authorized to arrange for the giving of systematic gymnasium training to all first year students who were not twenty-one years of age. It was also voted by the Faculty that systematic athletic work, under the direction of the athletic trainer appointed by the Advisory Council on Athletics, should be regarded as equivalent to the gymnasium work, and a Committee of the Faculty on Physical Training with the Dean, Medical Adviser and Director of the Gymnasium as ex-officio members, was appointed. Mr. Winfield C. Towne, Instructor in Physical Training, was authorized to prepare the gymnasium for class work, and to divide the first-year class into eight sections, each section to take one hour of work on two days of each week, beginning November 9. The Dean was also authorized to

secure lecturers to speak to the first-year students on the subject of Physical Training, and Professor Sedgwick and Dr. Sargent delivered such lectures, in addition to those usually given by Dr. White.

STATISTICS OF ILLNESS FOR THE SCHOOL YEAR 1907–08.

Fourth-year Class.

There were three hundred and twenty-six students in the fourth-year class. Of these, thirty were reported ill during the school year 1907–1908. Classified by illnesses, there were the following cases: appendicitis, 2; cold, 1; fever, 1; injury from fall, 1; internal strain, 1; malaria, 1; measles, 1; mumps, 5; ptomaine poisoning, 1; scarlet fever, 2; tonsillitis, 2; typhoid fever, 1; not specified, 11.

Third-year Class.

In this class there were three hundred and sixty-six students, of whom forty-nine were reported ill during the year. The following cases were reported: appendicitis, 2; cold, 4; diarrhœa, 1; trouble with eyes, 2; grippe, 11; injury to ear, 1; jaundice, 1; measles, 3; mumps, 3; scarlet fever, 2; sore foot, 1; sprained ankle, 1; surgical operation, 1; unspecified, 16. There was one death in this class, that of Mr. H. F. Foster, who died on May 20, 1908, of appendicitis.

Second-year Class.

This class numbered three hundred and seventy-one students, of whom fifty-nine were reported ill during the year. There were the following cases: abscess, 1; bronchitis, 2; cold, 2; concussion of the brain, 1; trouble with eyes, 2; grippe, 10; injury to leg, 1; jaundice, 3; measles, 8; mumps, 2; pleurisy, 1; scarlet fever, 1; surgical operation, 1; tonsillitis, 2; typhoid fever, 1; not specified, 20. The case of typhoid fever was that of Mr. Edward I. Cahill, and resulted in his death on April 23, 1908.

First-year Class.

The first-year class numbered three hundred and twenty-seven students. Of this number fifty-four were reported ill during the year. Classified by illnesses, there were the following cases: bilious attack, 1; broken cheek bone, 1; carbuncle, 1; cold, 3; grippe, 10; injury to knee, 1; jaundice, 1; measles, 3; mumps, 3; pulmonary tuberculosis, 1; surgical operation, 1; tonsillitis, 2; unspecified, 26. There were two deaths in this class; that of Mr. Walter L. Doane, who died of jaundice on April 25, 1908; and

that of Mr. Jesse Mathewson, who died of pulmonary tuberculosis on September 5, 1908.

SUMMARY.

	No. in Class.	No. Ill.	No. of Deaths.
Fellows and Graduates	20	0	0
Fourth Year	326	30	0
Third Year	366	49	1
Second Year	371	59	1
First Year	327	54	2
Total	1,410	192	4

ALFRED E. BURTON,
Dean.

REPORT OF THE MEDICAL ADVISER.

The medical work at the Institute has been carried on along the same lines as in previous years. Consultation hours were held on two afternoons a week throughout the year, and as usual this time was fully occupied by the students. On the majority of these days the time of consultation had to be extended to accommodate all those who came for advice. The average extra time needed was thirty-one minutes more than the appointed hour.

The following table gives the number of office visits made and the number of students seen. A few figures of previous years are given for comparison:—

	1906.	1907.	1908.
Total number of office visits made	345	409	318
Total number of different students seen	195	196	18
Greatest number of students seen per day			11
Least number of students seen per day			2
Average number of students seen per day			5
Number of students making more than one visit			45

The work of the medical office remains fairly constant from year to year and under the present arrangement does not seem likely to increase. The large majority of men found it necessary to make only a single visit; only four men made more than five visits; and seven was the greatest number made by any one

man. These facts seem to indicate that the great majority of the men have no difficulty in keeping in good physical condition throughout the year, and, on the other hand, that the Institute is no place for invalids. Several of the weaker men have been advised to distribute their work at the Institute over five instead of four years. I still found it necessary to point out to the less vigorous men the necessity of taking at least a few weeks actual vacation, just after their year's work, and just before beginning the fall term.

A great variety of illnesses were treated, the most numerous being digestive disturbances, diseases of the nose and throat, and surgical diseases. The following table shows in a general way the kind of diseases treated and the number of each:

Ear	5	Skin	25
Eyes	6	Specific Infections	25
Heart	6	Stomach and Bowel	30
Kidney	6	Surgical	45
Lungs	11	Miscellaneous	30
Nose and Throat	35		

Eight or ten men suffered from severe illnesses, such as appendicitis, typhoid fever, heart or kidney disease, all of which were more or less completely cured. One man had to leave the Institute on account of pulmonary tuberculosis and a small number of students were referred to specialists for treatment of the eye, ear, or skin. A few men were sent to the Massachusetts General or Boston City Hospital for the treatment of acute diseases, such as grippe, typhoid fever, appendicitis, etc.

In addition to the work of the Institute Office I have seen about fifty men at my private office and have been called to attend a smaller number of men at their residences.

The practice of asking for a sick excuse from class work without sufficient reason, which is often seen in our colleges, is practically unheard of at the Institute. Even excuses from Military Drill are rarely asked for without good reason. The only difficulty met with is in getting the men to take sufficient respite from work after an acute illness.

The posting of the following notice by Major Wheeler at the

suggestion of the Medical Adviser has proved useful in many ways:

"A doctor's certificate is required to explain absence from Military Drill on account of illness. If this is to be obtained from the Medical Adviser, men must report to him on the first office hour following their illness. (Monday or Thursday, 4–5 P.M., 27 Pierce Building.)"

This requirement, while increasing the work of the medical office but little, has largely prevented absence from drill without cause, and has brought some men promptly to see me who needed medical advice.

The number of cases of contagious diseases at the Institute, such as measles, mumps, scarlet fever, diphtheria, etc., is always very small. This is no doubt largely due to the scattered residence of the men. This year a few more contagious cases than usual appeared. This was due to the infection of one or two men in two of the fraternity houses, who in turn spread the infection to several of their mates in spite of every effort at isolation and disinfection. It is fortunate that such occurrences are so rare and limited at the Institute.

In addition to sick students ten healthy men were examined for the United States Civil Service. The Medical Adviser has occasional opportunity to help men to decide whether or not they are physically fit for certain sports, and to correct some physical ills which result from too rapid or insufficient training for athletic work.

Three talks on personal hygiene were given by the Medical Adviser to the Freshman class covering the following subjects: bathing; exercise; care of the eyes; the use of tobacco and alcohol; minor ailments, the emergency treatment of injuries; and also the prevalence and dangers of venereal disease. Some excellent pamphlets on sexual hygiene have been put in the hands of the Medical Adviser, but, it has seemed wiser to present the subject to the students in a personal talk, rather than by the distribution of pamphlets.

FRANKLIN W. WHITE,
Medical Adviser.

REPORT OF THE LIBRARIAN.

The record of accessions for the year ending September 30, 1908, shows a total addition to the Library of 4,563 items, a decrease of 327 over the previous year, and an increase of 572 over the year before. Of those added this year 1,338 were obtained by purchase, 1,654 by the binding of periodicals and books received in parts, and 1,571 are gifts, of which 740 are pamphlets.

The cost of the purchase of books and periodicals and the administration of the Libraries, exclusive of salaries, as shown by bills approved by the Librarian,* amounts to $8,015.87, an increase of $955.93 over last year.

The items of expenditure may be classified as follows:

BILLS APPROVED, 1907–1908.

Books and Binding	$5,846.65
Periodicals	1,933.94
Supplies	235.28
Total	$8,015.87

The net accessions to the Library, calculated by deducting from the gross accessions the number of books and pamphlets lost or destroyed or counted twice amounts to 4,421 items, including 3,641 volumes, 689 pamphlets, and 91 maps. The total is an increase over last year of 955 items.

The following table shows the way in which these accessions have been distributed among the several Libraries, together with their cost and the total contents of the Libraries.

* On page 45 of the Report for 1906–07, the total amount of bills approved should read $7,059.94 instead of $6,059.94.

TABLE OF THE NET INCREASE WITH THE COST OF THE SAME DURING THE YEAR 1907–08, AND THE TOTAL CONTENTS OF THE LIBRARIES OF THE INSTITUTE, SEPTEMBER 30, 1908.

LIBRARIES.	NET INCREASE.				TOTAL CONTENTS.	
	Volumes.	Pamphlets.	Maps.	Cost.	Volumes.	Pamphlets and Maps.
General Library:						
General	155	—	—	$73.24	7,394	5,069
English	22	—	—	42.25	3,498	44
Military Science	—	—	—	2.00	367	9
Walker Memorial	—	—	—	—	485	—
Other Departments	1	—	—	24.00	48	1
Totals General Library	178	—	—	$141.49	11,792	5,123
Architecture	115	10	—	609.17	4,155	261
Biology	134	49	—	201.75	3,537	769
Chemistry	609	160	—	1,137.40	11,295	2,195
Electrical Engineering	141	6	—	227.83	1,458	78
Engineering	766	147	—	1,237.75	14,376	5,023
Geology	488	44	88	338.54	3,708	2,943
History and Economics	367	163	—	452.01	12,658	3,751
Margaret Cheney Room	—	—	—	14.50	676	13
Mathematics	168	1[1]	—	280.85	1,911	261
Mining	264	11	3	361.22	4,764	737
Modern Languages	44	—	—	27.53	1,763	56
Naval Architecture	114	25	—	270.55[2]	1,352	144
Physics	253	75	—	546.06	8,357	1,240
Totals	3,641	691	91	$5,846.65	81,802	22,594

Owing to the large number and varied character of the periodicals and other serials received, it is difficult to keep records correctly and up to date. A careful revision, however, has been made again during this year, and omitting agricultural experiment station reports, financial reports of railroads, and college catalogues, it is found that we are receiving 1,117 periodicals and other serials. Of these 622 are paid for in cash, 203 received in exchange for the *Technology Quarterly*, and 292 are gifts.

[1] Excess of pamphlets bound over those received during the year. A pamphlet when bound is deducted from the number of pamphlets and added to the volumes.

[2] Including gifts from Dr. Charles G. Weld.

The distribution of these serials among the several Libraries, and the cost, with the account to which it is charged, are exhibited in the following table:

TABLE OF PERIODICALS AND OTHER SERIAL PUBLICATIONS RECEIVED DURING THE YEAR 1907–08, CLASSIFIED BY DEPARTMENTS AND METHOD OF PAYMENT.

LIBRARIES.	Number Received.					Estimated Cost.			
	Gifts.	Charged to Department.	Periodical Account.		Totals.	Department Account.	Periodical Account.		Totals.
			Subs.	Exch.			Subs.	Exch.	
General	52	15	33	27	127	$39.91	$122.82	$50.00	$212.73
Architecture	7	5	31	3	46	24.71	146.75	2.00	173.46
Biology	14	16	34	12	76	60.38	260.76	12.00	333.14
Chemistry	24	48	33	17	122	208.17	227.19	27.00	462.36
Electrical Engineering	10	12	14	4	40	35.85	65.36	10.00	111.21
Engineering	51	74	53	60	238	205.98	225.28	115.00	546.26
Geology	20	8	11	15	54	34.83	78.04	18.00	130.87
History and Economics.	72	55	38	4	169	120.14	109.74	8.00	237.88
Margaret Cheney Room,	—	6	—	—	6	17.35	—	—	17.35
Mathematics	2	3	16	2	23	6.05	73.53	3.00	82.58
Mining	12	13	25	34	84	46.47	106.36	67.00	219.83
Modern Languages	3	—	18	1	22*	—	79.60	2.00	81.60
Naval Architecture	5	12	6	4	27	56.75	20.23	8.00	84.98
Physics	20	20	23	20	83	92.98	104.76	28.00	225.74
Totals	292	287	335	203	1,117	$949.57	$1,620.42	$350.00	$2,919.99

While the foregoing tables exhibit the main facts in regard to the conditions of the Libraries, the work done in the office of the Librarian includes much more than is represented by these tables. The following statistics will give some idea of a part of this.

As the subject catalogue becomes more extended the routine work of cataloguing new books is made increasingly laborious and difficult, and the total number of cards written for each book varies from two to six and sometimes more, and then these are duplicated for one of the departmental libraries.

The total number of cards added to the general catalogue during the year is 5,932, an increase of 463 over the previous year, bringing the total number of cards in the catalogue up to 92,201.

* 10 kept in the General Library.

The number of orders issued for the purchase of books during the year was 1,208, a decrease of 60 over the previous year, and 1,530 orders were issued to the binders, 594 less than the previous record.

The number of books and periodicals borrowed for home use, so far as records have been kept, are as follows:

CIRCULATION.

General Library	1,456 volumes
Architectural Library	1,681 "
Biological Library	239 "
Chemical Library	2,071 "
Engineering Library	1,488 "
Mining Library	762 "
Naval Architectural Library	600 "
Physical Library	2,429 "

This table shows an interesting increase in the use of the Libraries. In the General Library the number has increased nearly 50 per cent. and there is a like increase in the Physical Library; while the increase in the Engineering Library is over 87 per cent.

It is noticeable that in four of the professional libraries, in this table, the circulation exceeds considerably that of the General Library. In the Architectural Library, there were borrowed also 2,053 pamphlets.

This table shows, not only something of the use of the Libraries by students and others, but it also shows a considerable increase of the work of the assistants in charge, who act as library attendants usually in addition to other duties.

The custom of keeping the General Library open until 10 o'clock in the evening seems to be now firmly established, although the attendance is still small. From October 3 to June 5, the Library was open in the evening 214 days. During this time the total attendance was, between five and seven o'clock, 1,501, between seven and ten o'clock, 824; making an average, between the hours of five and seven, of 7.0, and between seven and ten, of 3.8.

With a Library of upwards of 80,000 volumes, and a catalogue

containing over 90,000 entries, the Libraries of the Institute have reached a condition when the old simple method of making only a catalogue of authors no longer serves the purpose of finding books upon the shelves.

This condition has been realized for some time, and with the present efficiency of the personnel of the library staff, it has been possible, when new departmental libraries were established, to begin the catalogue in the right way by making it a complete catalogue with each book entered under at least three headings, namely, the author, the title, and the subject. This has been done for the newly established libraries in the Departments of Electrical Engineering and Naval Architecture.

As previously reported a complete subject catalogue for the Chemical Library was finished last year.

One of the most important of the departmental libraries is the Engineering Library, in which are combined the books for the Departments of Civil, Mechanical, and Sanitary Engineering. In this library of upwards of 14,000 volumes, with an annual increase of from 600 to 700, not including pamphlets, only a small beginning had been made in the formation of a subject catalogue, and it was found impossible to remedy this defect without additional help. The corporation has made, however, an appropriation to meet this, and at the end of the year under review, arrangements were made for the completion of the subject catalogue of the Engineering Library. Work is now going on and it is hoped at the next report to show substantial progress.

Soon after the office of Librarian was established, the custom was adopted by the Librarian of reading from time to time, as work permitted, the weekly lists of books published in the four principal publishing countries in the world, the United States, England, Germany, and France. Items which seemed of possible interest were checked, and an assistant copied these items upon order forms which were marked "Suggested for Purchase," and sent to the Heads of Departments. This custom has been continued to the present time.

As such matters of routine may be continued by a sort of official inertia, it is desirable to inquire into their usefulness from time to time. Therefore, just previously to writing this report, the Librarian addressed a letter to Heads of Departments inquiring into the desirability of continuing this practice, under four heads,—(1) As to whether books were brought to their attention which they would not have heard of otherwise; (2) As to whether titles suggested included subjects in which they were not interested; (3) Whether any subjects of interest were usually omitted; (4) Whether the Head of the Department would consider the discontinuance of these "Suggestions" any deprivation.

Of the fifteen persons addressed, replies were received from thirteen. Of these, eleven wished to have the "Suggestions" continued, nine without change from the usual custom; one desired only a limited class of books suggested, and one wished to have more subjects included in the "Suggestions" sent to him,—showing that, on the whole, the system of "Suggestions for Purchase" has been useful and should be continued.

The gifts to the Library during the year covered by this report have been many and varied.

Dr. Charles G. Weld has continued his generous gifts of books to the Department of Naval Architecture, the total number of volumes received from him during the year amounting to sixty-eight, including fifty-two volumes of the "Proceedings of the United States Naval Institute." From B. J. Tideman has been received a copy of his valuable "Memoriaal van de Marine, 1876–1880"; from Mr. Harry C. Bradley a set of eleven volumes of the "Journal of the Association of Engineering Societies"; and from Madame Veuve F. Roussin, a life of her husband, entitled "Le Chimiste Z. Roussin." Twenty-six volumes from the Library of the late Arthur H. Birks of the class of 1901 have been given to the Library by his family, and fifty-one volumes on engineering subjects have been received from Mrs. Charles K. Stearns from the library of her husband. Miss Myra W. Rafter has presented us with a complete set, eleven

volumes and twenty-six pamphlets, of the works of her father, the late George W. Rafter, distinguished as an hydraulic and sanitary engineer. From the Imperial Earthquake Investigation Committee of Japan, we have received a complete set of their publications in foreign languages; from the Royal Society of London the "Meteorological and Physical Results of the National Antarctic Expedition, 1901–1904"; from Mrs. Stone, a valuable set of "Engineering," containing fifty-eight volumes, and eighty volumes of other books on engineering subjects from the library of her husband, Mr. Joseph Stone of the class of 1868; and from Mr. Charles K. Needham of New Albany, Indiana, we have received, through his nephew, Albert F. Bemis, '93, a copy of a book by Manger on "Fire Proof Stairs," together with a translation in manuscript carefully prepared so that the two can be bound in one volume, which has been done at the expense of the donor.

Professor John O. Sumner has presented us with two volumes; Mr. Tove, with four Russian books on "Gold Mining"; George C. Whipple, '89, with a copy of his book on "Typhoid Fever"; Sylvester Baxter, Esq., Secretary of the Metropolitan Improvements Commission, a translation of Theodor Fischer's "City Building"; Charles Bradley, Esq., a handsome bound volume of the "Miscellaneous Writings" of Joseph P. Bradley, late Associate Justice of the United States Supreme Court.

Professors Charles B. Breed and George L. Hosmer have presented the Library with the second volume of their "Principles and Practices of Surveying." Senator W. Murray Crane and the Honorable Andrew J. Peters, M.C., have responded to our requests for public documents with unfailing courtesy. In addition to these, other gifts have been received from Professor Swain, Mrs. Richards, and other friends of the Institute. Mrs. William Barton Rogers has continued her generous contributions, providing, not only for a considerable part of the periodicals bought for the Library, but also giving valuable books, including four volumes on architectural subjects.

During the year a complete reorganization was made of the

Library staff, partly as the result of the resignation of Miss Helen C. McGowan, who had served at First Assistant with marked success for nearly ten years, and who left the Institute to accept the post of Assistant Librarian of Public Documents in the Office of the Superintendent of Documents at Washington.

The division of our Library among many departments, with varying demands, complicates the administration of the Librarian's office and makes experience on the part of the First Assistant a factor of more than usual importance. We were fortunate, however, in securing for this position Miss Bertha P. Trull, A.B. (Smith), who, in addition to a broad college education, had received special training in the Woburn Public Library.

ROBERT P. BIGELOW,
Librarian.

REPORT OF THE REGISTRAR.

This report is based on statistics gathered, as is customary, from the registration on November 1st.

The registration is much larger than the previous year, the number of students having risen from 1,410 to 1,426. The principal gain is in the first-year class, although there has been a marked increase in the number of students coming to the Institute from other colleges. The fourth-year class is also larger than last year, as is the number of resident fellows and advanced students. The percentage of regular students has risen from 64 to 65 in the past year.

The total number of members of the instructing staff as shown by the Catalogue this year, including those in the Department of Mechanic Arts, but excluding the Research Associates and Assistants and those who are announced annually as lecturers only, is 207. Counting all, there are 245. Not taking into account the Research Associates, Assistants and Lecturers, the ratio of members of the instructing staff to students in regular attendance is 1 to 7.1; while last year it was 1 to 6.7.

The first-year class is larger than for the last two years and the relative number of special students is smaller. In view of the fact that a large number of the special students admitted to the first-year class during the past few years were those who had failed to fulfil the additional entrance requirement in language, this decrease in the number of specials would seem to show that the preparatory schools are now better able to meet this requirement. In 1903 when this took effect the percentage of special students jumped to 37 per cent. from 11 per cent. the year previous. This has gradually dropped until now it has fallen to 19 per cent.

While the number of students in the engineering courses this past year has decreased 3 per cent., the number in all the other courses has risen 8 per cent. as compared with last year. The number of regular students in the engineering courses has gradually risen during the last ten years from 73 per cent. of the total number of regular students above the first-year, to 89 per cent. While the greatest gain in any one course is that in Sanitary Engineering, there has been almost as large a one in Chemical Engineering. An increase over the past year has also been noted in the number of students in Architecture, Chemistry, Electrical Engineering, Biology, General Science, and Naval Architecture.

The number of new students this year is 594, a larger number than ever before, except when the class of 1906 entered. The number of new students, other than regular first-year students, has also been larger only once before. The percentages of new students for this year and last year are 41 per cent. and 39 per cent. respectively.

The number of students at the Institute this year who are graduates of this or of other colleges has risen from 188 to 215, and they have come to the Institute from 91 colleges or universities, while last year only 85 were represented. Harvard has 16 representatives, the largest number from any one college. All the classes except the second-year class have more of these college students than last year, and the number entering the

fourth year has increased from 4 to 16. The number who have come after a college course of four years is likewise larger.

Besides the graduates there have come to the Institute from other colleges many new students who have not completed their college course. The total number of new students from other colleges is 170, forming 29 per cent. of all the new students. Although there were 15 less in this group last year, the ratio to the new students was one per cent. more.

The number of students who have registered in regular five-year courses has risen from 24 to 46. In view of the special attention that the Faculty has given during the last year to preparing regular five-year course schemes in several of the larger departments, there is likely to be an increase in the number of students who elect to spread the work of a professional course over five years. These five-year students are found more often in engineering than in the non-engineering courses.

The women students last year numbered but thirteen, while this year there are nineteen. Of these five are college graduates instead of one as noted last year. One woman is a candidate for an advanced degree.

The number admitted to the first-year class without conditions in 1900 was as high as 77 per cent., but now it has fallen to 48 per cent., which is the lowest for several years. The per cent. of first-year regular students admitted last year without conditions was 58. There has, however, been much less difference in the proportion of those admitted clear and with one condition.

While 20 per cent. of those admitted to the Institute on examination last year failed to enter, this was true of only 12.5 per cent. this year. An entrance examination fee took effect this last year except for those candidates who already held preliminary certificates. In view of the fact that a large number of those taking the entrance examinations did not have to pay the fee this last summer it is doubtful whether the number of those who entered the school was affected by this newly required fee.

There is this year a noticeable rise in the average age of the first-year students. During the past ten years this age has never exceeded 18 years, 11 months, but this year it has risen to 19 years, 1 month. A large number of first-year students this year are of what might be called unusual age for entrance. These, however, as has formerly been the custom, have been excluded from the computation. It is also interesting to note that an unusually large number of students from other colleges have entered the first-year class.

The graduating class this year contained a larger number (74 instead of 60) as well as a larger per cent. of men from other colleges than that of last year. Of the graduates from other colleges the largest group (classified on the basis of the number of years spent at the Institute) consisted of those who spent two years; but of the non-graduates, the largest group was of those who spent four years at the Institute. The average age of this graduating class was again 23 years. Of this class 63 per cent. as against 61 per cent. last year, received their degrees after studying at the Institute four years; and 32 per cent. of the class was made up of students who had studied at other colleges as compared with 28 of the previous year.

Forty-four states and two territories, the District of Columbia, the Philippine Islands, Porto Rico and the Canal Zone are represented in the list of students. Although Delaware and South Carolina have this year no representative on the list, North Carolina, Louisiana and Idaho are represented, while last year they sent no students to the Institute. There has been a decrease in the number of students from the North Central group of states but all the other groups show an increase. From California the number has risen from 14 to 20.

The number of Massachusetts students this year has risen from 731 to 839, making the percentage of students 57.2 which is a gain of 1.7 per cent. over the last two years. Although not the largest number of students that have attended the Institute from Massachusetts nor the largest per cent., it is the largest for four years. Again this year the number of Massachusetts

cities and towns sending students is 128. The ratio of Massachusetts students, generally, is larger in the non-engineering than in the engineering courses.

The foreign countries that this year have representation which last year were not represented are British Columbia, Cape Breton, Central America, Honduras, Jamaica, and Quebec. The number of foreign students has, however, fallen from 80 to 72. Thirty countries are represented by these 72 students, and the greatest number from any one foreign country are the ten students from China. Ten years ago, there were but 27 students representing only thirteen foreign countries.

The registration in the summer school was somewhat less than in 1907, dropping from 283 to 269. The loss was in the number of students taking courses to anticipate work, as the number of those who remained in the summer to make up failures or deficiencies was practically the same in these two years. Work was anticipated principally in applied mechanics, mechanic arts, descriptive geometry, the languages, the new course in mathematics, mechanical drawing, surveying, generally by those purposing to enter the Institute from other colleges.

The total number of undergraduate students assisted from Institute funds was 154, and the amount awarded was $19,100. In addition to this 73 students were aided by the State, of whom fifty were not aided by the Institute, making a total of 204 students receiving scholarship assistance.

The statistics from which these conclusions are drawn are printed on the following pages.

THE CORPS OF INSTRUCTORS.

	1906–07.	1907–08.	1908–09.
Professors	39	43	44
Associate Professors	18	18	18
Assistant Professors	21	25	33
	78	86	95
Instructors	69	72	62
Assistants	52	52	50
	121	124	112
Research Associates	8	8	6
Research Assistants	3	3	1
	11	11	7
Lecturers	31	32	31
Total	241	253	245

STUDENTS BY CLASSES.

Class.	Regular.		Special.		Total.	
	1907.	1908.	1907.	1908.	1907.	1908.
Resident Fellows (3) and Candidates for advanced degrees	20	26	—	—	20	26
Fourth Year	208	199	118	146	326	345
Third Year	187	210	179	155	366	365
Second Year	211	190	160	151	371	341
First Year	276	323	51	61	327	384
Total	902	948	508	513*	1,410	1,461

Yearly Registration since the Foundation of the Institute.

Year.	No. of Students.	Year.	No. of Students.	Year.	No. of Students.
1865–66	72	1880–81	253	1895–96	1,187
1866–67	137	1881–82	302	1896–97	1,198
1867–68	167	1882–83	368	1897–98	1,198
1868–69	172	1883–84	443	1898–99	1,171
1869–70	206	1884–85	579	1899–00	1,178
1870–71	224	1885–86	609	1900–01	1,277
1871–72	261	1886–87	637	1901–02	1,415
1872–73	348	1887–88	720	1902–03	1,608
1873–74	276	1888–89	827	1903–04	1,528
1874–75	248	1889–90	909	1904–05	1,561
1875–76	255	1890–91	937	1905–06	1,466
1876–77	215	1891–92	1,011	1906–07	1,397
1877–78	194	1892–93	1,060	1907–08	1,415
1878–79	188	1893–94	1,157	1908–09	1,462
1879–80	203	1894–95	1,183		

* Including 3 possible candidates for an advanced degree.

GRADUATES BY YEARS AND COURSES.

Year.	Civil Engineering.	Mechanical Engineering.	Mining Engineering.	Architecture.	Chemistry.	Metallurgy.	Electrical Engineering.	Natural History or Biology.	Physics.	General Course.	Chemical Engineering.	Sanitary Engineering.	Geology.	Naval Architecture.	Total.
1868	6	1	6	–	–	–	–	–	–	1	–	–	–	–	14
1869	2	2	–	–	1	–	–	–	–	–	–	–	–	–	5
1870	4	2	2	–	1	–	–	–	–	1	–	–	–	–	10
1871	8	2	5	–	2	–	–	–	–	–	–	–	–	–	17
1872	3	1	5	–	3	–	–	–	–	–	–	–	–	–	12
1873	12	2	3	1	7	–	–	–	–	1	–	–	–	–	26
1874	10	4	1	1	–	–	–	–	–	2	–	–	–	–	18
1875	10	7	6	1	1	–	–	–	1	2	–	–	–	–	28
1876	12	8	7	–	5	1	–	2	3	4	–	–	–	–	42
1877	12	6	8	4	2	–	–	–	–	–	–	–	–	–	32
1878	8	2	2	3	3	–	–	–	–	1	–	–	–	–	19
1879	6	8	3	1	3	–	–	1	1	–	–	–	–	–	23
1880	3	–	3	–	1	–	–	–	–	1	–	–	–	–	8
1881	3	5	6	3	8	–	–	1	–	2	–	–	–	–	28
1882	2	5	5	3	6	–	–	1	1	1	–	–	–	–	24
1883	3	7	5	1	3	–	–	–	–	–	–	–	–	–	19
1884	5	6	13	–	12	–	–	–	–	–	–	–	–	–	36
1885	4	7	8	2	4	–	2	–	–	1	–	–	–	–	28
1886	9	23	7	1	7	–	10	1	–	1	–	–	–	–	59
1887	10	17	8	1	9	–	8	1	1	3	–	–	–	–	58
1888	11	25	4	5	10	–	17	3	1	1	–	–	–	–	77
1889	14	24	5	3	8	–	17	1	1	2	–	–	–	–	75
1890	25	28	3	5	13	–	18	3	2	6	–	–	–	–	103
1891	18	26	4	6	11	–	23	3	3	1	7	–	1	–	103
1892	22	26	4	13	7	–	36	6	1	7	4	6	1	–	133
1893	25	30	5	2	8	–	41	2	–	6	8	–	2	–	129
1894	21	31	4	14	11	–	33	1	3	5	12	3	–	–	138
1895	25	30	3	15	14	–	33	–	2	4	11	4	–	5	144*
1896	26	34	10	24	17	–	48	3	3	7	7	4	3	5	190*
1897	25	40	7	16	20	–	33	2	3	7	12	4	1	9	179
1898	32	41	7	29	25	–	33	3	4	6	9	3	–	7	199
1899	30	37	9	22	22	–	32	2	2	1	10	1	–	8	173*
1900	32	34	21	21	19	–	23	3	3	5	11	4	–	9	185
1901	37	39	18	21	17	–	25	1	1	6	14	4	1	16	200
1902	24	46	14	18	14	–	35	5	3	3	9	7	–	14	192
1903	26	37	27	15	13	–	39	1	4	1	10	4	1	12	190
1904	34	45	32	24	15	–	34	3	13	5	7	2	1	17	232
1905	46	54	26	12	23	–	31	3	3	3	13	5	1	24	244
1906	47	69	38	22	21	–	37	2	7	–	10	6	–	19	278
1907	37	52	22	21	10	–	32	–	5	–	14	3	2	10	208
1908	48	61	19	19	16	–	38	4	2	–	15	2	–	5	229
Totals	737	924	385	349	392	1	678	58	73	96*	183	62	14	160	4,107*
Names counted twice, students graduating in two different years . . .															20
Bachelors of Science															4,087*
Masters of Science, not included in the above															38
Doctors of Philosophy, not included in the above															3
Total . . .															4,128*

* Deducting names counted twice (students graduating in two courses).

STATISTICS OF ADMISSION.

	Regular.	*Special.*	*Total.*
Admitted clear	138	0	138
" with one condition	76	11	87
" with two conditions	50	6	56
" with three conditions	22	10	32
" with four conditions	2	1	3
" on examination	288	28	316
Total First-year Class	323	61	384

Admitted but did not enter 41

Candidates at June Entrance Examinations 657

Candidates rejected in June:

Complete candidates	24
Final "	21
Preliminary "	54
Partial "	28
	127

Candidates in September for Entrance and Advanced Standing Examinations 321

Candidates rejected in September:

Complete candidates	21
Final "	13
Preliminary "	15

Certificates of the College Entrance Examination Board submitted 92

Total Registration and Number of New Students.

Year.	(1) Total No. of Students.	(2) No. of Students in the Catalogue of the previous year who remain in the Institute.	(3) No. of New Students entering before issue of Catalogue.	(4) Of those in column (3) the following number are regular First-year Students.	(5) No. of New Students not of the regular First-year Class.
1899–1900	1,178	764	414	275	139
1900–1901	1,277	789	488	312	176
1901–1902	1,415	844	571	396	175
1902–1903	1,608	949	659	432	226
1903–1904	1,528	1,042	486	249	237
1904–1905	1,561	986	575	295	280
1905–1906	1,466	984	482	213	269
1906–1907	1,397	862	535	272	263
1907–1908	1,415	888	527	273	254
1908–1909	1,462	868	594	323	271

NEW STUDENTS FROM OTHER COLLEGES.

Class, by Year, Joined at Institute.	Years Spent at College.						Total.
	One.	Two.	Three.	Four.	Five.	Six.	
First	20	4	1	3	—	—	28
Second	12	17	—	19	—	—	48
Third	—	10	6	59	3	—	78
Fourth	—	—	2	11	2	1	16
Total	32	31	9	92	5	1	170

GRADUATE STUDENTS.

Colleges and Universities Represented.

Acadia	1	Maryland Agricultural	1
Adrian	1	Massachusetts College of Pharmacy	1
Albright	1	Massachusetts Institute of Technology	22
Allegheny	1	Michigan College of Mines	1
Amherst	6	Middlebury	2
Anatolia	1	Mississippi Agricultural	1
Austin	2	Montevideo	1
Bates	1	Mount Holyoke	1
Beloit	2	Nebraska	1
Boston College	1	North Carolina	1
Boston University	2	Northwestern	1
Bowdoin	3	Notre Dame	1
Brown	3	Ohio Northern	1
California	2	Ohio Wesleyan	1
Canisius	1	Oklahoma	1
Carleton	1	Oregon Agricultural	1
Central College	1	Pennsylvania College	2
Central University	1	Pennsylvania University	1
Chicago	3	Pomona	1
Coe	1	Princeton	9
Colorado College	2	Richmond	1
Colorado University	1	Rhode Island Agricultural	2
Cornell	3	Rochester	7
Dakota Wesleyan	1	Rutgers	1
Dalhousie	1	Saint Johns	1
Dartmouth	5	Santa Clara	1
DePauw	1	Southwestern Presbyterian	1
Earlham	1	Texas Agricultural	1
Emory	1	Texas University	4
Fairmount	1	Trinity, Cambridge University	1
Georgetown	1	United States Military Academy	1
Georgia School of Technology	1	United States Naval Academy	13
Harvard	16	Vanderbilt	1
Haverford	2	Virginia	2
Holy Cross	3	Virginia Military	2
Illinois	2	Washington and Jefferson	3
Indiana	2	Washington and Lee	2
Iowa	3	Wellesley	1
Iowa State	1	Wesleyan	4
Japanese Naval Engineering	1	Whitman	2
Johns Hopkins	3	Williams	6
Kingston School of Mines	1	Wooster	1
Leland Stanford Junior	1	Worcester Polytechnic	1
Louisiana	1	Yale	12
McGill	1		218
Manitoba	1	Counted twice	3
Marietta	3	Total	215
Marquette	1		

Graduates who are candidates for Advanced Degrees 26
Graduates who are pursuing undergraduate work 189
Colleges and Universities represented 92

COURSES OF INSTRUCTION.

REGULAR AND SPECIAL STUDENTS BY COURSES FOR THE CURRENT YEAR.

YEAR.		Civil Engineering.	Mechanical Engineering.	Mining Engineering and Metallurgy.	Architecture.	Chemistry.	Electrical Engineering.	Biology.	Physics.	General Science.	Chemical Engineering.	Sanitary Engineering.	Geology.	Naval Architecture.	Total.
4th	Reg.	43	37	18	14	7	40	2	4	1	13	8	—	12	199
	Sp.	26	22	17	17	14	21	6	4	1	9	5	2	2	146
3d	Reg.	43	43	17	7	8	47	2	5	1	18	9	—	10	210
	Sp.	22	23	20	24	10	30	5	—	—	6	8	—	7	155
2d	Reg.	34	43	15	5	5	44	2	2	1	20	12	—	7	190
	Sp.	27	28	15	18	14	24	3	4	—	5	10	—	3	151
Tot.	Reg.	120	123	50	26	20	131	6	11	3	51	29	—	29	599
	Sp.	75	73	52	59	38	75	14	8	1	20	23	2	12	452
Total		195	196	102	85	58	206	20	19	4	71	52	2	41	1,051

THE SAME CLASSIFICATION FOR THREE YEARS.

YEAR.	Civil Engineering.	Mechanical Engineering.	Mining Engineering.	Architecture.	Chemistry.	Electrical Engineering.	Biology.	Physics.	General Science.	Chemical Engineering.	Sanitary Engineering.	Geology.	Naval Architecture.	Naval Construction.
1906–07 .	210	214	100	94	49	192	10	18	0	55	32	2	43	17
1907–08 .	210	226	118	82	53	200	17	20	2	59	39	0	37	16
1908–09 .	195	196	102	85	58	206	20	19	4	71	52	2	41	13

NUMBER OF STUDENTS PURSUING CERTAIN LEADING BRANCHES OF STUDY.

	First Year.	Second Year.	Third Year.	Fourth Year.	Total.
Mathematics	409	318	156	6	889
Physics	—	311	332	79	722
Chemistry	378	104	123	97	702
English	353	297	33	—	683
Mechanic Arts	—	138	67	84	289
French	190	22	24	—	236
Geology	—	69	121	31	222
German	124	40	41	—	205

REGULAR FIVE-YEAR STUDENTS.

YEAR.	Total.	Civil Engineering.	Mechanical Engineering.	Mining Engineering.	Architecture.	Chemistry.	Electrical Engineering.	Biology.	Physics.	General Science.	Chemical Engineering.	Sanitary Engineering.	Geology.	Naval Architecture.
1st . . .	4	–	–	–	–	–	–	–	–	–	–	–	–	–
2d	1	1	–	–	–	–	–	–	–	–	–	–	–	–
3d	8	–	2	–	–	–	1	–	1	–	1	2	–	1
4th . . .	10	2	5	–	–	–	2	–	–	–	1	–	–	–
5th . . .	23	5	4	4	1	1	6	–	1	–	–	1	–	–
	46	8	11	4	1	1	9	0	2	0	2	3	0	1

WOMEN STUDENTS.

COURSE.	Architecture.		Chemistry.		Biology.		Total.
Year of the Course.	Regular.	Special.	Regular.	Special.	Regular.	Special.	
Graduate	1	–	–	–	–	–	1
Fourth	3	2	1	1	–	–	7
Third	–	1	1	–	–	3	5
Second	–	1	–	1	–	1	3
Special, without course classifications . . .	—	—	—	—	—	—	3
Totals	4	4	2	2	–	4	19

STATISTICS OF GRADUATION, CLASS OF 1908.

Number receiving degree at end of one year	4
" " " " " " two years	32
" " " " " " three "	20
" " " " " " four "	144
" " " " " " five "	26
" " " " " " six "	4
Total number of degrees of S.B. awarded	230*
Number entering from other colleges	74
" graduates	42
" non-graduates	32

*Including one as of the Class of 1907 and one recommended since June.

FURTHER STATISTICS OF THE STUDENTS FROM OTHER COLLEGES OF THE GRADUATING CLASS, JUNE, 1908.

Yrs. at the Inst.	*Graduate.*	*Non-graduate.*	*Total.*
1	2	2	4
2	26	5	31
3	10	10	20
4	2	14	16
5	2	1	3
	42	32	74

AGES OF THE MEMBERS OF THE GRADUATING CLASS, JUNE, 1908.

Under 20½	4
Between 20½ and 21	6
" 21 " 21½	16
" 21½ " 22	40
" 22 " 23	53
" 23 " 24	51
" 24 " 25	20
" 25 " 26	16
26 and over	24
Total	230*

The average age was 23 years.

AGES OF THE REGULAR FIRST-YEAR STUDENTS.

PERIOD OF LIFE.	1907–1908.		1908–1909.	
	Half-year Groups.	Yearly Groups.	Half-year Groups.	Yearly Groups.
16 to 16½ years	1	—	—	—
16½ to 17 "	4	5	3	3
17 to 17½ "	14	—	11	—
17½ to 18 "	34	48	20	31
18 to 18½ "	45	—	50	—
18½ to 19 "	54	99	64	114
19 to 19½ "	41	—	69	—
19½ to 20 "	30	71	31	100
20 to 20½ "	14	—	30	—
20½ to 21 "	9	23	11	41
21 to 22 "	16	16	11	11
	262	262	300	300

Repeating the first year 4
Students of unusual age 19
Average age, omitting these 23 . . . . . 19 years, 1 month

* Including one as of the Class of 1907 and one recommended since June.

SUMMER SCHOOL.

	1907.	1908.
Number from other colleges and schools attending	58	52
Number not referring to any other college or school	1	3
Number from Massachusetts Institute of Technology	224	214
	283	269
Number who registered, but did not attend	10	7
Number who applied, but cancelled registration	3	6
Registrations for failures or deficiencies	186	184
Registrations to anticipate work	347	312

NUMBER OF STUDENTS REGISTERED IN EACH OF THE COURSES OF THE SUMMER SCHOOL FOR THIS YEAR AND THE YEAR BEFORE.

	1907.	1908.
Analytic Geometry	29	0
Applied Mechanics	19	48
Carpentry and Wood Turning	12	7
Chemistry, Inorganic and Analytical	47	46
Chipping and Filing	8	4
Descriptive Geometry	37	34
Design	18	14
Forging	16	9
French	14	4
German	16	5
Integral Calculus	6	22
Machine Tool Work	27	16
Mathematics	—	19
Mechanical Drawing	14	14
Mechanical Engineering Drawing	20	21
Mechanism	13	21
Metal Turning	1	5
Organic Chemical Laboratory	11	8
Pattern Work	14	8
Physical Laboratory	9	8
Physics	30	29
Precision of Measurements	4	9
Shades and Shadows	4	6
Surveying	35	17

RESIDENCE OF STUDENTS.

NUMBER OF STUDENTS IN EACH YEAR, FROM 1902, COMING FROM EACH STATE OR TERRITORY.

STATES AND TERRITORIES.	1902.	1903.	1904.	1905.	1906.	1907.	1908.
North Atlantic.							
Connecticut	43	44	48	50	36	29	31
Maine	35	34	26	22	18	23	22
Massachusetts	935	869	889	807	764	781	839
New Hampshire	34	23	36	32	26	27	24
New Jersey	8	13	16	11	15	17	14
New York	96	104	94	71	84	82	99
Pennsylvania	44	52	56	58	55	57	53
Rhode Island	40	28	19	24	23	28	28
Vermont	12	11	5	5	4	5	6
Total	1,247	1,178	1,189	1,080	1,025	1,049	1,116
South Atlantic.							
Delaware	4	3	2	1	2	1	–
Dist. of Columbia	17	15	17	13	12	10	10
Florida	2	2	4	3	3	3	6
Georgia	6	4	6	8	4	2	3
Maryland	27	25	18	19	17	18	17
North Carolina	6	7	1	–	1	–	1
South Carolina	4	–	–	1	3	2	–
Virginia	7	7	4	7	8	9	11
West Virginia	–	–	–	1	2	3	3
Total	73	63	52	53	52	48	51
South Central.							
Alabama	1	1	1	1	2	4	3
Arkansas	1	1	–	1	–	2	1
Kentucky	11	9	8	5	5	5	4
Louisiana	2	2	5	1	2	–	3
Mississippi	–	4	4	4	5	3	3
Tennessee	3	5	2	2	3	6	8
Texas	9	11	13	16	15	16	16
Total	27	33	33	30	32	36	38
North Central.							
Illinois	49	44	43	42	37	31	23
Indiana	14	6	10	10	15	12	9
Iowa	8	6	9	13	14	16	14
Kansas	1	1	4	7	6	5	4
Michigan	10	9	9	10	7	8	7
Minnesota	10	9	11	13	14	8	8
Missouri	20	22	25	29	17	14	6
Nebraska	5	4	5	4	2	3	2
North Dakota	1	1	1	–	3	4	3
Ohio	43	37	35	34	30	26	30
South Dakota	1	3	2	–	1	3	3
Wisconsin	11	13	14	12	7	12	12
Total	173	155	168	174	153	142	121
Western.							
California	15	19	18	23	21	14	20
Colorado	10	11	16	17	12	10	5
Idaho	–	–	–	–	–	–	1
Montana	3	2	5	3	3	3	2
Nevada	–	–	–	1	1	1	1
New Mexico	1	1	2	–	–	1	1
Oklahoma	–	–	–	–	–	1	1
Oregon	4	7	8	5	2	3	4
Utah	2	3	3	2	3	3	5
Washington	3	3	2	2	5	12	13
Wyoming	1	–	–	2	5	1	1
Total	39	46	54	55	52	49	54

District.	1902.	1903.	1904.	1905.	1906.	1907.	1908.
Canal Zone	–	–	–	–	–	–	1
Hawaii	–	1	1	1	2	2	1
Philippine Islands	–	–	4	2	3	1	1
Porto Rico	2	2	4	5	2	3	6
Total	2	3	9	8	7	6	9
Total for the United States	1,561	1,478	1,505	1,400	1,321	1,330	1,389

NUMBER OF STUDENTS IN EACH YEAR, FROM 1902, COMING FROM EACH FOREIGN COUNTRY.

Foreign Countries.	1902.	1903.	1904.	1905.	1906.	1907.	1908.
Argentine Republic	–	–	–	–	1	2	2
Armenia	–	1	1	3	2	2	2
Australia	2	3	1	3	3	3	–
Austria	–	–	–	–	–	–	–
Belgium	–	–	–	–	1	1	–
Bermuda	1	1	–	1	1	–	–
Brazil	5	3	3	1	–	2	3
British Columbia	–	–	–	–	1	–	1
Cape Breton	–	–	–	–	–	–	1
Cape Colony	–	–	–	–	1	1	1
Central America	–	–	1	–	–	–	1
Chile	1	1	1	2	1	1	1
China	1	2	8	8	7	9	10
Costa Rica	–	–	–	–	–	2	3
Cuba	2	3	4	4	4	4	2
Denmark	1	1	1	1	1	1	–
Ecuador	–	–	1	–	2	2	2
Egypt	–	–	–	1	2	2	2
England	3	4	4	5	6	4	3
France	–	–	1	1	–	–	–
Germany	1	2	–	–	–	–	–
Honduras	–	–	–	–	1	–	1
India	–	1	1	2	1	1	2
Ireland	1	1	–	2	2	3	1
Italy	–	–	–	2	–	2	1
Jamaica	–	–	1	–	1	–	1
Japan	1	2	1	3	5	3	4
Korea	–	–	2	–	–	–	–
Malta, Island of	–	1	1	–	–	–	–
Manitoba	1	1	–	–	–	–	–
Mexico	10	8	4	7	12	12	6
New Brunswick	2	1	2	4	3	2	1
Nova Scotia	8	9	4	1	4	3	4
Ontario	2	2	5	6	6	4	7
Panama	–	–	–	–	–	1	–
Paraguay	–	–	–	–	–	1	1
Peru	–	–	–	1	1	2	2
Poland	–	–	–	–	–	1	–
Quebec	–	1	2	1	1	–	1
Russia	–	–	–	–	–	2	2
Scotland	1	1	2	1	1	1	–
Sweden	–	–	1	–	–	–	–
Syria	–	1	1	–	–	–	–
Transvaal	–	–	1	3	3	3	2
Turkey	4	–	2	1	1	2	1
Uruguay	–	–	–	2	1	1	1
Total	47	50	56	66	76	80	72
Total in school	1,608	1,528	1,561	1,466	1,397	1,410	1,461

RESIDENCE OF STUDENTS FOR THIS SCHOOL YEAR.

States.	Candidates for Advanced Degrees.	Fourth Year.	Third Year.	Second Year.	First Year.	All Regular Students.	Special Students.	Total.
Alabama	–	1	1	–	–	2	1	3
Arkansas	–	–	–	–	1	1	–	1
California	–	1	3	2	7	13	7	20
Canal Zone	–	–	–	1	–	1	–	1
Colorado	–	2	–	–	1	3	2	5
Connecticut	–	3	6	3	10	22	9	31
Dist. of Columbia	–	1	2	2	1	6	4	10
Florida	–	1	–	1	2	4	2	6
Georgia	–	1	–	–	–	1	2	3
Hawaii	–	1	–	–	–	1	–	1
Idaho	–	–	–	–	–	–	1	1
Illinois	1	2	3	2	3	11	12	23
Indiana	–	3	–	1	3	7	2	9
Iowa	–	5	1	–	–	6	8	14
Kansas	–	–	–	1	1	2	2	4
Kentucky	–	1	–	1	1	3	1	4
Louisiana	–	–	1	–	–	1	2	3
Maine	–	5	3	6	2	16	6	22
Maryland	–	5	2	2	2	11	6	17
Massachusetts	15	103	126	124	215	583	256	839
Michigan	–	–	2	1	4	7	–	7
Minnesota	–	1	2	–	–	3	5	8
Mississippi	1	1	–	–	–	2	1	3
Missouri	–	3	–	1	–	4	2	6
Montana	–	–	–	1	–	1	1	2
Nebraska	–	–	–	–	1	1	1	2
Nevada	–	1	–	–	–	1	–	1
New Hampshire	–	3	6	2	6	17	7	24
New Jersey	1	1	–	3	7	12	2	14
New Mexico	–	–	–	–	–	–	1	1
New York	2	11	14	12	19	58	41	99
North Carolina	–	1	–	–	–	1	–	1
North Dakota	–	–	1	1	1	3	–	3
Ohio	–	4	4	3	3	14	16	30
Oklahoma	–	1	–	–	–	1	–	1
Oregon	–	–	1	1	–	2	2	4
Pennsylvania	–	11	13	1	7	32	21	53
Philippine Islands,	–	–	–	–	–	–	1	1
Porto Rico	–	–	–	–	3	3	3	6
Rhode Island	1	5	2	3	5	16	12	28
South Dakota	–	–	1	–	–	1	2	3
Tennessee	–	1	1	1	1	4	4	8
Texas	2	5	1	2	1	11	5	16
Utah	–	1	–	1	1	3	2	5
Vermont	–	–	2	2	2	6	–	6
Virginia	–	2	3	1	–	6	5	11
Washington	–	1	2	–	–	3	10	13
West Virginia	–	–	–	1	–	1	2	3
Wisconsin	–	1	3	3	1	8	4	12
Wyoming	–	–	–	–	–	–	1	1
Total	23	189	206	186	311	915	424	1,389
Foreign Countries.								
Argentina	–	–	–	–	–	–	2	2
Armenia	–	–	–	–	1	1	1	2
Brazil	–	1	–	1	–	2	1	3
British Columbia	–	1	–	–	–	1	–	1
Cape Breton	–	–	–	1	–	1	–	1
Cape Colony	–	–	–	–	–	–	1	1
Central America	–	–	–	–	1	1	–	1
Chile	–	–	–	–	–	–	1	1
China	2	2	–	–	2	6	4	10
Costa Rica	–	–	–	–	2	2	1	3
Cuba	–	–	1	–	–	1	1	2
Ecuador	–	–	–	–	1	1	1	2
Egypt	–	–	–	–	–	–	2	2
England	–	1	–	–	–	1	2	3
Honduras	–	–	–	–	1	1	–	1
India	–	–	–	–	1	1	1	2
Ireland	–	–	–	–	–	–	1	1
Italy	–	–	–	–	–	–	1	1
Jamaica	–	–	–	–	1	1	–	1
Japan	–	–	–	1	–	1	3	4
Mexico	–	2	–	–	–	2	4	6
New Brunswick	–	–	–	–	–	–	1	1
Nova Scotia	–	1	–	1	1	2	2	4
Ontario	–	2	–	–	1	3	4	7
Paraguay	–	–	–	–	–	–	1	1
Peru	–	–	–	–	–	–	2	2
Quebec	1	–	–	–	–	1	–	1
Russia	–	1	1	–	–	2	–	2
Transvaal	–	1	–	–	–	1	1	2
Turkey	–	1	–	–	–	1	–	1
Uruguay	–	–	–	–	–	–	1	1
Total	3	10	4	4	12	33	39	72

RESIDENCE OF MASSACHUSETTS STUDENTS.

County.	No. of Towns.	No. of Students.	County.	No. of Towns.	No. of Students.
Barnstable	1	5	Middlesex	28	252
Berkshire	5	17	Nantucket	1	2
Bristol	5	19	Norfolk	18	95
Dukes	2	2	Plymouth	16	34
Essex	22	105	Suffolk	4	257
Franklin	4	5	Worcester	15	23
Hampden	4	20	Total	128	839
Hampshire	3	3			

FROM CITIES WHICH SEND FIVE OR MORE STUDENTS.

Boston	238	Springfield	11	Concord	7
Newton	47	Gloucester	10	Holyoke	7
Brookline	39	Quincy	9	Salem	7
Cambridge	30	Wakefield	9	Wellesley	7
Somerville	27	Winchester	9	Watertown	6
Malden	19	Brockton	8	Arlington	5
Lowell	17	Everett	8	Barnstable	5
Newburyport	14	Framingham	8	Danvers	5
Lawrence	13	Haverhill	8	Marlboro	5
Waltham	13	Hyde Park	8	North Adams	5
Taunton	12	Medford	8	Pittsfield	5
Lynn	12	Beverly	7		

DISTRIBUTION OF MASSACHUSETTS STUDENTS, ABOVE THE FIRST YEAR, AMONG THE COURSES.

YEAR.		Civil Engineering.	Mechanical Engineering.	Mining Engineering and Metallurgy.	Architecture.	Chemistry.	Electrical Engineering.	Biology.	Physics.	General Science.	Chemical Engineering.	Sanitary Engineering.	Geology.	Naval Architecture.	Total.	
4th Year	Reg.	19	22	9	6	4	20	–	3	–	8	6	–	6	103	
	Sp.	10	13	8	4	10	6	4	4	1	5	3	–	–	68	
3d Year	Reg.	25	25	12	3	7	30	2	5	1	8	6	–	2	126	
	Sp.	8	12	6	8	4	11	2	1	–	3	6	–	2	62	
2d Year	Reg.	25	23	10	2	5	28	2	1	–	15	11	–	2	124	
	Sp.	17	16	9	7	10	11	3	2	–	3	7	–	2	87	
1st Year	Reg.	–	–	–	–	–	–	–	–	–	–	–	–	–	215	
	Sp.	–	–	–	–	–	–	–	–	–	–	–	–	–	39	
Total	Reg.	69	70	31	11	16	78	4	9	1	31	23	–	10	353	824 Adv.
	Sp.	35	41	23	19	24	28	9	6	1	11	16	–	4	217	15 Deg.
Totals		104	111	54	30	40	106	13	15	2	42	39	–	14	570	839

WALTER HUMPHREYS,
Registrar.

Reports of Departments.

DEPARTMENT OF CIVIL AND SANITARY ENGINEERING.

No changes in the staff of the Department have occurred during the past year, except that one assistant, Mr. Clarence D. Howe, resigned to accept the position of Professor of Civil Engineering at Dalhousie University, Halifax, Nova Scotia. This left one vacancy among the assistants, and one additional assistant having been authorized by the corporation, Messrs. Howard B. Luther and Mason T. Whiting were appointed. The staff of the Department is now larger than ever before, consisting of four professors, two associate professors, four assistant professors, two instructors, and eight assistants.

During the past year Professors Breed and Hosmer published the second volume of their treatise on Surveying, thereby completing the work as planned. This book has already been adopted in a large number of the technical schools of this country.

The curriculum of the Course in Civil and Sanitary Engineering has not been changed during the past year. The senior class will, during the present year, experience the effect of the change made two years ago, by which one year of modern language was removed from the Course, and instruction in mechanics begun in the second year. It is not intended, on account of this change, to cover any more ground than previously; but it will be possible to devote more time to some of the subjects, and it is hoped that the instruction will in consequence be more thorough.

Owing to the business depression, the demand for graduates has been less this year than for many years past. Notwithstanding this, a large number of men who graduated last June

have found positions. Of a total of 76 men belonging to the class of 1908, 9 have returned to the Institute for further study, 2 have returned as assistants, and 37 are known to be employed elsewhere, leaving 28 unaccounted for. Many of these last are undoubtedly employed, but have not notified us of the fact; and, with the revival of business, if the experience of the past is any guide for the future, the demand for our men will soon greatly exceed the supply.

It is gratifying to note the number of graduates of this Department who are engaged in teaching. Reference has been made to Mr. Clarence D. Howe, who has taken charge of the Department of Civil Engineering at Dalhousie University, and reference may also be made to one of the graduates of the Class of 1908, Mr. Allston Dana, who has gone to the University of Montana. During the summer, also, one of the graduates of 1907, Mr. Fred W. Morrill, was sent to Tientsin, China, to take charge of the Department of Civil Engineering at the Imperial University. Another of the graduates of 1907, Mr. Hudson B. Hastings, has been made Assistant Professor at Bowdoin College.

The particular needs of the Department at the present time are increased space and the relief of the curriculum by the transfer of the field work in surveying to the summer.

With reference to space, while the number of students in the Department is not increasing very rapidly, and, while it is not desired that it should, nevertheless, there is great need of additional space because our drawing rooms are already crowded to their full capacity. The library, also, is growing so fast that it affords entirely inadequate opportunity for students to use it as a place for study. Within a year or two, if its growth continues as it has in the past, it will be practically only a storehouse for books.

There will be differences of opinion with reference to the advisability of increasing our numbers. Personally, however, I believe that it would be wisest not to allow our numbers to increase much above what they are at present, but to gradually

raise the standard of scholarship throughout the Institute so that we may turn out more first-class men. There are in the Institute, as in other educational institutions, men who ought not to be there; some because of lack of ability, and some because their abilities lie in other directions. Many of these men, of course, drop out before the conclusion of the Course; but, nevertheless, a good many remain. This question, of course, is one of general policy, which should be applied to all departments alike; but in any case it is to be expected that there should be a gradual, if slow, increase in the number of students, while if adequate room were available for expansion, and no effort were made to keep down the numbers by raising the standard, the growth might be quite rapid. In Cornell University, for example, the number of students in the Department of Civil Engineering (in all four classes) has increased from 326 in 1903–04 to 499 in 1907–08. There are many advantages in a large school, provided the number of teachers keeps pace with the increase in the number of students, and provided the increase in teachers is not made by increasing the number of assistants, but by increasing the number of members of the Faculty as well.

In the Department of Civil Engineering there are fewer students now per teacher than there were ten years ago. A comparison in this respect may be instructive. In 1897–98 there were 4 professors, 1 assistant professor, 3 instructors, and 3 assistants, a total of 11 teachers; while the number of students was 155, giving an average of 14 students per teacher and 31 students per professor. In 1907–08 there were 4 professors, 2 associate professors, 4 assistant professors, 2 instructors, and 7 assistants, a total of 19; while the number of students was 227, giving an average of 12 per teacher and 23 per professor.

SUMMER SCHOOL OF SURVEYING.

With reference to the desirability of relieving the crowded curriculum by the transfer of the field work in surveying to the summer, I have already reported in previous years, and I wish once more to urge the importance of this matter. The Institute should either purchase or lease a large tract of land in one of the New England States, and should provide a summer camp, equipped to accommodate some one hundred and fifty students. In this camp, instruction should be given during the summer in the surveying field work now given in our second year, the railroad and surveying field work now given in the third year, and the hydraulic field work now given in the fourth year. The best plan would seem to be to require every student at the end of the second year to spend eight weeks at this camp, of which time, four weeks would be devoted to the surveying field work now given in the second year and the remaining four weeks to the field work now given in the third and fourth years. It might be well to allow students the option of taking the entire work in one summer, that following the second year, or in two summers, taking in the summer following the first year the four weeks course in elementary surveying and in the summer following the second year the four weeks course in railroad and advanced surveying and hydraulic field work.

A camp for carrying on this work, on the basis of one hundred and fifty students at one time, should be provided with one main building, containing two rooms to be used as lecture rooms, drawing rooms, or living rooms which would have an area of 2,500 or 3,000 square feet; also a building containing a kitchen and dining-room; another building containing an instrument room and supply room and several sleeping rooms for students who may be ill or who for some reason cannot occupy tents; an ice house, and a sanitary. It would be expected that the students would ordinarily sleep in tents provided with wooden floors. The estimated cost of these build-

ings and of the other things necessary to furnish a permanent camp is as follows:—

Main building (unfurnished)	$3,500.00
Building containing dining-room and kitchen (unfurnished)	2,700.00
Building containing instrument and supply rooms, with sleeping rooms overhead	1,500.00
Ice house	200.00
Sanitary	100.00
Tents and floors ($50 per tent)	2,000.00
Cot-beds and washstands	600.00
Boats	300.00
Water supply (uncertain, but possibly)	1,200.00
Furnishing of dining-room and kitchen	2,000.00
Furnishing of drawing room	200.00
	$14,300.00
10 per cent. for contingencies	1,400.00
	$15,700.00

Some of the above items are rather uncertain, and especially the cost of water supply. The cost of purchasing or leasing a proper site is also very uncertain. It would appear probable however, that for $25,000 a permanent camp could be provided, including the cost of the land, or its capitalized cost, if leased.

In case this plan can be carried out, the present summer school in elementary surveying, now given by Professor Robbins each summer, and also the summer school in advanced surveying now given every other summer, would both be discontinued. Owing to the relief of the curriculum, moreover, the regular work for the year could probably be done with three fewer assistants than would otherwise be required. The following, therefore, is an estimate of the actual net financial result which might follow the change recommended:—

ANNUAL EXPENSE OF TRANSFERRING WORK IN SURVEYING TO THE SUMMER.

Interest on first cost, say 5% of $25,000	$1,250.00
Repairs (uncertain) and insurance	500.00
General expenses	500.00
Care of camp	250.00
Salaries: Professors Robbins, Hosmer, Russell, and Breed, one instructor and 5 assistants, say $1,200 per month for two months	2,400.00
Total	$4,900.00

Deduct salaries of three assistants during school year, @ $500 . .	$1,500.00
Net additional cost of summer camp	$3,400.00
Net cost of present summer schools, variable, but say	400.00
	$3,000.00

The last deduction is intended to represent the net cost of the summer course given by Professor Robbins and one assistant each summer, and of the summer school given in alternate years. Both of these courses, however, are optional, and the students taking them pay for them, the fee for the summer course being $25 and for the summer school the same. The net cost of these schools, therefore, varies with the number of students. In 1907, the gross cost of the summer school in advanced surveying was $969.35, but there were 31 students, each of whom paid $25, so that the receipts were $775, making the net cost for the school about $200. In other years the number of students and also the number of instructors has been less, so that the cost is a variable.

This leads naturally to the question whether students should be required to pay an additional fee for the summer courses, if made obligatory. The objection to doing so would be that the cost of the Course in Civil Engineering would thereby be made greater than the cost of other Courses of the Institute and this might deter some students from taking this Course. Students would in any case, I assume, be required to pay for their board and lodging a sum sufficient to defray the expenses of the camp, other than estimated above. If it should appear to the Corporation desirable, as I believe it would be, to charge a small fee for the summer courses, it appears that with one hundred and fifty students a fee of $20 each would just about cover the cost of the summer work, while if a fee of $10 were charged the deficit would be $1,500, chargeable to summer work.

The uncertainties of this estimate are, of course, apparent, and there is no way of making a closer estimate at present. With reference to the salaries, however, I wish to state that, if this summer work is undertaken, the instruction should be given not mainly by young assistants, but largely by teachers of

a higher grade. I believe that some other schools make the mistake of putting the students in the summer schools largely under the care of inexperienced teachers, many of them perhaps students in higher classes. I do not advocate this policy for the Institute.

Summarizing the above, it appears probable that the recommended change could be made by the permanent investment of some $25,000, the interest on which, together with the cost of running the school, would result in an annual expense to the Institute not to exceed $3,000, and that this might be entirely or partially wiped out, as might seem best to the Corporation, by charging a fee not exceeding $20 per student. It may be added that with such a fee it is probable that the cost to each student for the eight weeks would not be over $75, and might, perhaps, after a little experience be made considerably less. Whether this would deter many men from taking the Course in Civil Engineering is a question which I cannot attempt to answer. I believe the above estimates to be outside figures.

The following table indicates the practice with reference to the work in surveying at other prominent schools in various parts of the country. The table shows the number of hours devoted to surveying during each year and during the succeeding summer periods, and it will be seen that all of the engineering schools included in the table, with the exception of the University of Illinois, require summer work in surveying. The table further shows that almost all of these schools, in addition to the summer work, give a considerable amount of instruction during the term. This instruction, however, is probably work in the class room and drawing room which can be arranged without disorganizing the curriculum.

APPROXIMATE TOTAL NUMBER OF HOURS ASSIGNED TO SURVEYING.

School.	During School Year.			During Summer Vacation following (on basis of 8 hours per day).		
	1st year.	2d year.	3d year.	1st year.	2d year.	3d year.
University of California .	144	108	—	—	192	192
Columbia University . .	60	—	—	288	336	192
Cornell University . . .	105	57	90	—	—	216
Case School	176	296	180	—	176	—
Harvard University . .	—	—	—	—	—	672
University of Illinois . .	—	135	—	—	—	—
University of Michigan .	—	150	60	—	—	288
Rensellaer Institute . .	time	not	stated	—	—	288
Rose Polytechnic Institute	—	270	72	96	—	—
Sheffield Scientific School	—	—	90	—	144	144
University of Wisconsin .	30	135	—	—	192	—
Worcester Polytechnic Institute.	—	240	—	—	144	288

The extent to which the curriculum is interfered with, if it is attempted to give surveying during the school year, is serious. Before the Back Bay was built over, it was comparatively easy for the Institute to teach surveying during the term without undue waste of time, because the students could gain their practice in the immediate vicinity of the Institute buildings. As the Back Bay was built up, however, it became necessary for the students to go further and further away in order to find a suitable site, and for a number of years it has been our custom to devote three entire days per week to field work in surveying. The second-year work is divided into two sections, one of which devotes Tuesdays and the other Thursdays to field work during the fall and spring, while the third-year is also divided into two sections, both devoting all day Wednesday to field work, either in surveying or in railroad location. All of the assistants in the Department, and a considerable number of the members of the Faculty, therefore, are entirely unavailable for other work during three entire days of the week during the field-work season. The interference that this causes with the Tabular View, especially in the case of students who wish to take subjects in two different years, will be apparent.

In view of the above facts, and as stated in my previous report on the subject, I strongly urge the Corporation to take steps immediately to secure a proper site and to authorize the establishment of a summer camp where all surveying field work shall be taught.

GEORGE F. SWAIN.

DEPARTMENTS OF MECHANICAL ENGINEERING AND APPLIED MECHANICS.

Notwithstanding the general depression in business, it appears, from the evidence that the Department has been able to obtain, that of the sixty-one young men who graduated in the Course in Mechanical Engineering in June, 1908, all were provided with positions by the middle of October, and nearly all of them much earlier. Moreover, many applications for graduates have been received which it has been impossible to fill.

The principal addition to the equipment has been the Westinghouse Parsons Steam Turbine of five hundred kilowatts capacity, which was installed during the summer in that portion of the former lunch room which was added to the Mechanical Engineering Laboratory. The space thus gained amounted to about 2,000 square feet. Approximately one-half of this space is occupied by the steam turbine and its auxiliary apparatus; namely, a condenser, circulating pump, wet pump, dry air pump, etc. The turbine is set on an I-beam foundation, thus leaving the space underneath open. The floor of the room is of cinder concrete, five inches thick. This floor has been stiffened by I-beams resting on piers built in the sub-basement. The floor plates of the turbine are about sixteen inches above the floor of the room, and thus all the small piping and connections underneath are exposed. An Alberger surface condenser was also installed during the summer, with the steam entering at the bottom, and hot air well be-

neath the steam opening. The circulating water is drawn from a canal thirty inches wide and three feet deep, which was dug and concreted in the sub-basement. This canal is connected with the water reservoir in the Henry L. Pierce building and with that in Engineering A. The circulating water is pumped from the canal by a Lawrence Centrifugal Pump, with a discharge seven inches in diameter, driven by a thirty-five horse-power vertical engine, set on a masonry foundation. The condensing water is piped to the cooling tower, from which it returns to the canal and reservoirs through piping installed some years ago. A dry air pump, formerly located elsewhere in the laboratory, has been transferred to the turbine room and is connected with the top of the condenser. When experiments on the turbine are in progress, the condensed steam is discharged into tanks set on scales, so that it can be weighed. The water supplied to the glands comes from the condensed steam, so that leakage from the glands will introduce no error in the steam weight.

In order to investigate the behavior of the steam while passing through the turbine, thirteen connections have been made in the rotor casing to gages, so that pressures can be noted at every point where the length of blade and the diameter of the rotor changes.

The power of the turbine is absorbed by a water brake designed and built by the Westinghouse Company. This brake consists of a wheel of broad face on the rotor shaft, provided with teeth like those of a milling cutter. The casing which surrounds this wheel has teeth on its inner circumference. Water is delivered into the space between these two wheels. The outer casing has an arm which connects with a weighing system of levers. A trolley crane of six tons capacity has been built over the turbine.

For a number of years, tests of turbine plants varying in capacity from five hundred to five thousand kilowatts have been made by students, under the direction of the Department, for thesis work; but the limitations necessarily imposed upon

outside plants have prevented us from carrying on such investigations as we shall now be able to pursue with a plant of our own of practical size; and this turbine will enable us to study experimentally many problems connected with the performance of this motor, including questions of steam losses, leakages, brake effect of moisture in the entering steam, etc. We shall thus gain a great deal of information that is now only in the possession of turbine builders and is treated by them as a trade secret.

In consequence of the very important position that the steam turbine has taken as a prime mover, an additional Option in Steam Turbine Engineering has been added to the Course in Mechanical Engineering, so that those students who select this Option may now extend their study of the steam turbine beyond that pursued by all students of the Course in Mechanical Engineering. This Option includes a discussion of the arrangement and construction of various types of steam turbines and of the methods of determining sizes and proportions required for the development and distribution of power and the securing of sufficient strength and favorable conditions for operation.

A considerable amount of original work has, as usual, been carried on in the laboratories of the Department. A few of the investigations pursued in connection with the thesis work of the last school-year are:—

1. Friction and Velocity of a Steam Nozzle, forming the thesis of Mr. Edwin F. Church, Jr., for the degree of Master of Science.

2. An investigation of the friction of high-pressure air flowing in pipes. For this purpose, piezometer rings were used on each side of each fitting, and the losses due to fittings and to straight runs of pipe were noted.

3. An investigation to determine the cause of the occasional freezing of the moisture in the air-distributing valve of the engine and tender equipment of the air brake system.

4. The study of the causes of failure of locomotive driving-

springs and their remedies has been continued,—a question that is of great importance to the railroads and the locomotive builders.

5. An investigation of the proper methods of securing a running balance in the case of machinery with a high rotative speed.

6. Additional work has been done in the investigation of reinforced concrete beams.

Some of the new investigations that will be undertaken this year are:—

1. A study of the oscillations and of the effects of inertia of shaft governors, in consequence of change of load on the engine, or from any other causes.

2. A study of the action of different types of safety valves.

3. Investigation of spray nozzles for cooling condensing water.

The following gifts were made to the Department during the past school year:—

1. A large locomotive steam injector, presented by the Shutte Koerting Company.

2. A sectional injector presented by the same company.

3. A Steam Engine Indicator with an outside spring, presented by the Star Brass Company.

4. A set of detailed blue prints of a modern Mallet Compound Locomotive presented by the Baldwin Locomotive Works.

5. Valves presented by the following firms: the Hancock Inspirator Company, the Crosby Steam Gage and Valve Company, the Star Brass Company, the Lunkenheimer Company, the Jenkins Company, and the Fairbanks Company.

Much valuable literature has been provided at our request for the use of students by a large number of manufacturing firms.

Valuable modern apparatus has been lent to the Department, some for use in connection with investigations and some for use in connection with the work in the Drawing Room, by the B. F. Sturtevant Company, by Hill, Clarke & Company,

by the Holtzer-Cabot Company, by the Charles J. Jager Company, and by the Fitchburg Steam Engine Company.

The most pressing needs of the Department are,—

A refrigerating plant, an impact testing machine, a gas producer plant, an hydraulic accumulator, and a stationary plant for testing locomotives.

More room is also needed to relieve further present crowding, to provide for new apparatus, to furnish room to carry on thesis work on apparatus brought in from outside, and to provide room for stripping machines for the purposes of Machine Drawing, and also room in which large concrete beams and columns can be made.

I desire to emphasize once more the great importance of increasing the staff of the Department by the appointment of a number of research assistants. A full statement in connection with this matter was contained in my report of last year.

GAETANO LANZA.

DEPARTMENT OF MINING ENGINEERING AND METALLURGY.

Need of more Space.—The apparatus installed this year in an already overcrowded space emphasizes still more the need for at least double the present floor area for the department laboratories.

Changes in the Work of Instruction.—A change has been made in connection with the arrangement of laboratory hours in assaying which it is hoped will allow students to accomplish more work in a given time. Students now come into the laboratory from 11 A.M. to 4. P.M once a week with an hour for luncheon instead of two afternoons from 2 to 4 as formerly.

The subject of elementary metallurgy given to students in the Electro-chemistry Course in the first term of the fourth

year has been transferred to the second term and combined with the subject of electro-metallurgy.

In the laboratory there have been carried on three reverberatory furnace smelting operations, one with lead and two with copper; one of the copper refining runs has been replaced by zinc desilverization of argentiferous lead and by blast roasting of galena concentrate, thus extending the scope of the regular laboratory operations of the first term of the fourth year.

Equipment.—The following additions have been made to the equipment:—feeder for trommel, Johnston vanner, callow tank, Pierce amalgamator, triplex rolls, hand jig 12 in. square, new classifiers (given by R. H. Richards), pulsator jig and classifier 4 in. square, Calkins advance laboratory crusher, Braun disc pulverizer, Denver Fire Clay Company soft coal muffle, Hendrix combination agitator, Hendrix copper agitator, turbidimeter for sulphur determinations, ammeters, machine lathe, transferred from the Mechanical Laboratories, a hand diamond drill, a standard rock drill, and a pneumatic hand drill, loaned by the Sullivan Machinery Company.

Researches of the Staff.—Professor Richards spent three months of the summer in the western states inspecting concentrating mills. He now has the third volume of his work on ore-dressing nearly completed. Professor Locke made a professional trip to New Mexico. Professor Bugbee maintains his connection with the United States Geological Survey, and last summer made examinations of mines and mining districts in Idaho and Washington. This work enables him to keep in touch with mining conditions in the West and to enlarge his knowledge of the mining districts of the country. For other more special lines of investigations see the list of publications.

Advanced work.—W. Mostowitch, a Russian Metallurgist, who came to us last November, carried on a valuable piece of research work which has recently been read before the October meeting of the American Institute of Mining Engineers.

Two graduates of the class of 1908 are working for advanced degrees: one is preparing a thesis on the Wilfley table and the

other on heats of formation of some ferro-calcic-silicates. Two other students from the Michigan College of Mines and from Queen's College, Kingston, Ontario, are also doing advanced work.

Students.—The second, third, and fourth years average about 32 students each, 98 in all, showing that the numbers are keeping up.

Professional Positions.—The graduates were not seriously affected by the depression in business, only a few being out of work. Nearly all of the class of 1908 secured work during the summer. Summer work in mining and metallurgy was also secured for a large percentage of the third-year class, and also for some of the second-year.

Summer School.—A very interesting summer school of mining engineering and metallurgy was held in Nova Scotia, in which studies were made of the following: iron mines of the Londonderry Iron & Mining Co. at Torbrook; geology at Parrsboro; coal mines at Spring Hill; coal mines at Joggins; electric power plant from coal at mine at Chignecto; rolling mills of the Nova Scotia Steel & Coal Co. at New Glasgow; coal mines of the Acadia Coal Co. at New Glasgow; government diamond drill at New Glasgow; Boston Richardson gold mines and mill and bromo-cyanide plant at Goldboro; coal mines of the Dominion Coal Co. at Glace Bay; extensive plant of the Dominion Steel Co. at Sidney; and the coal mines of the Nova Scotia Steel and Coal Co. at North Sydney.

ROBERT H. RICHARDS.

DEPARTMENT OF ARCHITECTURE.

This year the Department of Architecture opened with an increase of fourteen students over the register of last year, and with a class of unusual size and strength taking fifth-year work. Seven members of this class are last year's graduates who have returned for the Master's degree. The fifth-year work shows a most satisfactory growth, which is due to the demand for more

highly trained men than those graduated in the regular Course, and perhaps to a certain extent to a reaction from the opinion until recently prevalent that the American architectural schools are hardly more than feeders of the Paris École des Beaux-Arts. More and more do our students both from abroad and on their return home speak with increased respect for the training received at the Institute, a training not fully appreciated till the Paris atelier and the Beaux-Arts' exhibitions give the opportunity for comparison. A recent example of what our standard means is shown in the case of one of our '07 graduates, who passed the examination at the Paris Beaux-Arts and entered first in architecture over all Frenchmen and foreigners. It appears as if our Travelling Fellows would, in the future, give more and more attention to travel, and the careful study of classic monuments of architecture with only incidental work in the French atelier or the American Academy in Rome.

The loyalty of former students of the Department has been markedly shown this year. Mr. Robert P. Bellows, '04, made a most interesting exhibition in our rooms of his work accomplished at the Beaux-Arts, of which he is a "diplomé." He also prepared a very careful paper on the foreign school methods and atelier ways of study, which he delivered to our students. Mr. F. L. W. Richardson, '03, after an exhibition of some of his foreign work, presented us with three water-colors, which now hang on the library walls. Mr. A. W. Longfellow, '78, has given us a large copper plate engraving of the "Leaning Tower of Pisa." He gave it "in memory of happy, useful days at the school where I gained so much. I should like to be remembered there, and send it in grateful memory." This also decorates our library. We are glad of this opportunity to record another of the many kind things done for us by Mrs. William B. Rogers. A gift of books, photographs, and engravings from her has an additional value in their association with one who has done so much for the Institute. Miss Helen M. Longyear, a present student who was in Europe last summer, has filled many a gap in our library by a most generous gift of photographs collected while travelling.

The first three-year scholarship given by the American Academy in Rome was to be granted without competition, and among the candidates from those eligible for this honor, Mr. Ernest F. Lewis, '07, received the appointment. It was a great compliment to the Institute, and we are glad to say that Mr. Lewis is proving himself well worthy of the confidence placed in him. An interesting, illustrated article explaining what the Academy in Rome stands for, written by Mr. Lewis, was sent to the Technology Architectural Record, and appeared in the August number. This year a regular competition takes place for the Academy scholarship, and a number of our students will take part in it.

Mr. Andrew N. Rebori, '07, was the winner of the 1908 Travelling Fellowship. Again Mr. Guy Lowell came to our aid and generously added five hundred dollars to a like sum granted from the Austin Fund to make this Fellowship possible for a year. Mr. Rebori sailed in September. Miss Ida A. Ryan, the previous beneficiary of this Fellowship, has recently returned after a year's study in Europe. As a result of her accomplishment she has received a very flattering invitation to take an important position in the office of one of our best architectural firms.

Mr. George E. Burnap, a graduate in the Option in Landscape Gardening and a beneficiary of a Travelling Fellowship from the Austin Fund, has also recently returned. His successful work had brought him to the knowledge of Cornell University, and he was invited to the position of instructor in the Rural Art Department, which he accepted.

The Rotch Prize of two hundred dollars for regular students was awarded to Mr. Edgar I. Williams, who has returned for a graduate year, and is a candidate for the advanced degree. There was no candidate for the special student prize.

There is little to be said in regard to our regular course of study. No radical changes have been made since last year. The steadily increasing demand, however, from the profession, for the highest standard of work from the schools is a very

effective stimulus to improve methods and avoid ruts, and we believe that each year finds us fully prepared to meet every requirement. The rapid progress in the methods of scientific construction demands continuous exertion in the Option in Architectural Engineering; and the preparation of material for use in the class room, the correction of students' work, etc., entail too great an amount of clerical labor which falls on Professor Lawrence at the expense of time that would be far better employed in the further development of the Course.

Fully appreciating the impossibility of obtaining more floor area for the use of the Department, we still desire to call attention to our growing needs for more class rooms and a larger exhibition hall.

We renew our plea that the Department be so endowed that a one-thousand dollar Travelling Fellowship may be awarded each year. The Executive Committee has already signified its willingness to allow five hundred dollars from the Austin Fund for this purpose, and it is earnestly hoped that a like amount may be secured from some other source. Not to have this fellowship is a great handicap in the accomplishment of the results we are striving for. We cannot make rules as to eligibility and invite candidates for competition if we are not sure beforehand that there is a fellowship to offer. Our plea, besides, is for nothing more than what every architectural school of standing in the country has enjoyed for many years.

F. W. CHANDLER.

DEPARTMENT OF CHEMISTRY AND CHEMICAL ENGINEERING.

It is a matter of much gratification to the Department that the hopes expressed in the departmental report of 1907 have been realized in the formal organization, in June, 1908, of the Research Laboratory of Applied Chemistry as a division of the Department, under the immediate charge of Professor William

H. Walker as Director. The steps which have led to this very desirable outcome have been outlined in previous reports; and a more detailed statement of the present status and future plans of the Laboratory will be found on page 90. There are good reasons for the expectation that this extension of the activities of the Department will prove most beneficial both in promoting close and helpful relations with the industries of the country and in the increased incentive and opportunity which it presents for research work on the part of members of the instructing staff and advanced and graduate students.

The increase in the number of students to be provided for in analytical and organic chemistry has made it necessary to extend the laboratory accommodations for both. This has been accomplished by transforming an additional recitation room on the second floor of the Walker Building into a laboratory for analytical chemistry, and utilizing a larger proportion of the laboratory on the fourth floor, formerly devoted entirely to analytical chemistry, for students in organic chemistry. This arrangement, while meeting numerical requirements for the present in a way to avoid a more disadvantageous and uneconomical division of the classes in organic chemistry, is far from satisfactory, and emphasizes a need for the more efficient housing of the Department, referred to later.

Of the candidates for the degree of Doctor of Philosophy, three, Messrs. George A. Abbott, Charles A. Kraus, and Edward W. Washburn, received that degree in June. Dr. Kraus remains at the Institute as Research Associate in Physical Chemistry, Dr. Washburn has been called to the position of Associate at the University of Illinois, and Dr. Abbott has charge of the instruction in Chemistry at the Indianapolis Manual Training High School.

In accordance with our custom in recent alternate years, the Summer Course of Industrial Chemistry was held under the direction of Professor Thorp, lasting from June 10 to June 27. The party of students numbered nineteen, seven from

the Course in Chemistry, one from the Course in Biology, and eleven from the Course in Chemical Engineering, most of them being members of the class of 1908. They were accompanied by Mr. John F. Norton, Assistant in Industrial Chemistry, and for a part of the time by Professor Talbot, beside Professor Thorp, who conducted the usual conferences. Visits were made to the following plants:—

Standard Sugar Refinery, South Boston, Mass.
Manhattan Rubber Co., Passaic, N.J.
Colgate & Co., Jersey City, N.J.
Tide Water Oil Co., Bayonne, N.J.
Murphy Varnish Co., Newark, N.J.
Berganport Chemical Works, Bayonne, N.J.
Nichols Copper Co., Laurel Hill, L.I.
J. T. Baker Chemical Co., Phillipsburg, N.J
Bethlehem Steel Co., South Bethlehem, Pa.
Lehigh Portland Cement Co., Ormrod, Pa.
American Plate Glass Co., James City, Pa.
James Mfg. Co., James City, Pa.
Pennsylvania Window Glass Co.
American Acid and Alkali Co., Bradford, Pa.
Atlantic Refining Co. (Eclipse Works), Franklin, Pa.
Galena Signal Oil Co., Testing Laboratory.
Colburn Machine Co.
Macbeth-Evans Glass Co., Charleroi, Pa.
National Tube Works, McKeesport, Pa.
Harbison-Walker Refractories Co., Hays Station, Pa.
H. J. Heinz Co., Pittsburg, Pa.
National Lead and Oil Co., Pittsburg, Pa.
Crucible Steel Co., Pittsburg, Pa.
Carnegie Steel Co., Duquesne, Pa.
American Sheet and Tin Plate Co., Vandergrift, Pa.

The Institute and the Department are again under great obligations to the representatives of these firms and corporations for the courtesies extended to our students. The unquestioned success of the trip and the great benefit which the students derived from the Course is largely due to them. A more detailed account of this trip has been prepared for the *Technology Review* by Professor Thorp.

In response to the third annual request of Harrison Brothers and Company, a second-year student was nominated to par-

ticipate in their summer course in Industrial Chemistry; namely, Mr. George P. Lunt, of Danvers, Mass., of the Course in Chemical Engineering. He and Mr. John A. Christie, the nominee of last year, derived much benefit from their experience in the works laboratories, an experience which affords an unusual opportunity for an insight into conditions under which the chemical industries are carried on, and which enables those who participate in it to better appreciate the opportunities afforded them in the later years of their undergraduate course. It is much to be desired that other firms should cooperate with educational institutions in a similarly helpful way.

At the request of the New England Association of Chemistry Teachers a course of lectures on Industrial Chemistry is being given by Professor Frank H. Thorp in connection with the Lowell Teachers School of Science. The lectures are given in the Institute lecture rooms, and are designed especially for the needs of teachers of chemistry in the secondary schools. These lectures, together with the course on Physical Chemistry given last year by Professor Lewis under similar auspices, and a course on "The Electrolytic Dissociation Theory" given by Professor Talbot before the Brooklyn Institute of Arts and Sciences, may serve as examples of the extension of the departmental service to those outside of the Institute classes. Beside these more formal lecture courses, a large number of individual talks and papers are delivered each year by members of the Department before a wide variety of organizations and involve in the aggregate a very considerable public service.

The changes in methods of instruction during the past year have related to improvement in details. The few changes in the instructing staff occurring at the close of the year chiefly concerned the junior members. Messrs. Blanchard and Woodman received deserved promotion to assistant professorships. Owing to ill health Professor Miles S. Sherrill has been obliged to ask for leave of absence for a part of the present

year; but it is anticipated that he will soon be able to resume his efficient service. During his absence his work is carried on by Professor Lewis and Mr. Richard C. Tolman. The Department is fortunate in being able to command their assistance in this emergency.

Each year the plea for a new building for the work of the Department becomes more urgent. During the past year the conditions in the laboratories of water and food analysis have become such that efficient instruction is possible only at a sacrifice on the part of instructors which is greater than should be demanded of them, and which prohibits desirable development of work along these lines. Similar conditions have prevailed in the laboratory for sugar analysis for some time, and instruction in both organic and analytical chemistry is hampered by disadvantageous distribution of the students in the several laboratories. The often expressed need for a chemical museum remains unsatisfied, and that for a suitably equipped lecture room for the sole use of the Department, and properly connected with such a museum, becomes more and more urgent. An increase of space for the work in industrial chemistry will soon be demanded, and funds are needed for the purchase or erection of some larger types of apparatus than are now employed, in order that this laboratory may become in some measure a laboratory of chemical engineering, as well as of applied chemistry.

Imperative as all these needs are, and much as the Department would benefit by their fulfilment, it is probable that an even greater benefit would accrue from the association of the different branches of the Department under one roof. In place of the present comparative isolation of certain laboratories and instructors, with the attending frequency of contact with their colleagues, would come an increased appreciation of community of purpose and interest and a better correlation of the work of the Department, and the present stimulating effect of the Research Laboratories would be much enhanced. How much the concentration of the work of the Department

in one, or at most two, buildings (instead of the present distribution through portions of four buildings) would mean can only be fully appreciated after visits to other institutions which are more fortunately situated in this respect.

H. P. TALBOT.

THE RESEARCH LABORATORY OF PHYSICAL CHEMISTRY.

During the past year several protracted investigations have been brought to a satisfactory conclusion. The complete revision of the methods of qualitative analysis, undertaken by Professor Noyes and Dr. William C. Bray, is now finished in so far as it relates to all the common metals and the more important of the rare metals. Mr. Roger D. Gale has made much progress also towards extending the new system to include the acid radicals.

Dr. Edward W. Washburn has published the results of a research of three years' duration on the degree of combination between water and dissolved salts. The data, which were obtained only after surmounting the most formidable experimental difficulties, unquestionably afford the most important contribution that has yet been made to our quantitative knowledge of hydration in solution. Dr. Washburn has also published, at the request of the editor of the *Jahrbuch der Radioaktivität und Elektronik*, an exhaustive summary of the present status of the hydrate theory.

Another investigation which has just been finished was begun by Dr. Charles A. Kraus over four years ago. During this time he has studied from nearly every possible point of view, the properties of the unique substances formed by the solution of metals in liquid ammonia, and in determining their quasi-metallic character has thrown a new light on the nature of the metallic state.

The extensive investigation of electrical conductivity and

allied properties of aqueous solutions has been generously supported by an annual grant to Professor Noyes from the Carnegie Institution of Washington. This year the grant was increased to $3,000. The work has developed in several new directions. Dr. Johnston studied the conductivity and freezing point of the higher types of electrolytes; Mr. Arthur C. Melcher determined the solubility of a number of salts at high temperatures; and Mr. Roy D. Mailey is engaged in determining data concerning the physical properties of water and water vapor near the critical point, which promise to be of the highest scientific and technical value.

The series of determinations of electrode potentials previously made in this laboratory has been continued by Dr. Carl L. von Ende, who succeeded in finding the true value for the thallium electrode and in explaining the strange anomalies observed by previous investigators. The potentials of the alkali and alkaline earth metals, notwithstanding their very great importance, have never been measured because of the extreme reactivity of these metals. This problem is now being attacked by Dr. Kraus and Professor Lewis. The potential of sodium has already been found, and with a higher degree of accuracy than has hitherto been reached in the case of any solid metal. This investigation has been aided by a grant of $300 from the Bache fund of the National Academy of Sciences.

Two weekly seminars are conducted in the present term, one by Dr. Bray on the applications of the phase rule, and one by Professor Lewis on thermodynamics. A weekly conference of all men engaged in research affords an opportunity for the full discussion of experimental problems while they are in process of solution, and thus in a certain sense every investigation is carried on with the collaboration of the whole research staff. Last spring the laboratory instituted the Physico-Chemical Colloquium, which takes the form of an evening smoker. At each meeting some topic in theoretical chemistry is presented by one of the members, and a general discussion follows. This Colloquium has proved a marked success, and is being attended

not only by all members of the Research Laboratory, but also by a number of men from other departments of the Institute and from neighboring colleges.

The Research Laboratory has always extended a hearty welcome to men of mature attainments who desire to take advantage of the facilities for investigation which the laboratory offers. This hospitality was extended last year to Professor Carl L. von Ende, from the University of Iowa, and more recently to Professor Kenneth L. Mark, of Simmons College, who is studying the phenomenon of gaseous absorption.

Several members of the research staff have recently been called to other laboratories by greater inducements in salary and opportunity than can be offered here. It is becoming increasingly difficult to retain the services of men who combine a thorough knowledge of chemistry with proficiency in research. Besides the call from other institutions of learning, there has been a remarkably rapid growth in the demand for experienced investigators from the scientific bureaus of the government, from the new laboratories for technical research, and from special laboratories such as those founded by the Carnegie Institution. While the loss of our trained men to these institutions frequently means an unfortunate interruption of an important investigation, it is inevitable; and indeed the training of men for such responsible positions must be regarded as one of the chief functions of our Research Laboratory.

GILBERT N. LEWIS.

THE RESEARCH LABORATORY OF APPLIED CHEMISTRY.

In the reports of the Department of Chemistry for the last two years, the great desirability of establishing at the Institute a Research Laboratory in which some of the many problems which now confront the industrial and manufacturing public could be investigated, has been clearly emphasized.

As a result of a generous donation from Mr. Charles W. Hubbard and the appropriation by the Executive Committee for this purpose of a part of the income of the Charlotte B. Richardson Fund for Industrial Chemistry, the foundation of a Research Laboratory of Applied Chemistry was made possible, and its organization was effected at the beginning of the present school year. Room 53, Pierce Building, has been partly refitted, and is now devoted to the work of the Laboratory, while Room 50, Engineering B, has been equipped as a shop with the lathes and tools necessary for building experimental apparatus.

Those Professors of the Department of Chemistry more closely associated with industrial work form the staff in whose care the management of the Laboratory is placed. It is at present constituted as follows: Professors William H. Walker, Henry P. Talbot, Willis R. Whitney, Augustus H. Gill, and Frank H. Thorp. Dr. Warren K. Lewis, who as Austin fellow spent the last two years in study at the University of Breslau, and Dr. William Guertler from the University of Göttingen, Germany, have been engaged as Research Associates and are now devoting their entire time to the problems under investigation. Dr. Peter Burns of the Department of Chemistry is giving a portion of his time to research work and is a member of the Laboratory force.

At the request, and with the co-operation of the H. P. Hood Milk Co., an investigation has been undertaken with a view to determining the cause of the alleged rapid deterioration of modern tin plate. This is a matter which concerns vitally all users of tin plate, and the problem is considered of sufficient importance to devote to it the entire time of a Research Associate. The manufacturers of tin plate are also co-operating in the work, and it is hoped that the investigation may lead to a more satisfactory knowledge of the causes of the trouble, and to some suggestions as to how the present difficulties may be met. A problem which is of growing importance and which confronts all the manufacturers of galvanized sheet iron, lies

in the production of what is known as "gray sheets." The American Sheet and Tin Plate Co. of Pittsburg, Pa., has placed at the disposal of the Laboratory sufficient funds to make a thorough investigation of this difficulty, and work towards its solution is now being energetically carried on. Two objects for research which have been undertaken by graduate students are the casehardening of iron, with reference to special alloy steels, and the physical and chemical properties of linseed oil in relation to its capability of protecting iron and steel from corrosion.

Dr. Burns is devoting his time to the development of a series of laboratory experiments with descriptive text designed for the use of students in the engineering courses, and treating of the chemical properties of the materials employed in engineering practice and the chemical principles of those processes with which the engineer most frequently deals. It is felt that there is an increasing demand for such a text-book in all schools of engineering, and that this Laboratory will render a real service in providing for engineering students a work of this kind.

During the present term Professor Walker conducts a weekly seminar upon the principles of chemical engineering, to which is attracted a number of the members of the instructing staff and advanced students. In the second term Dr. Lewis will offer a seminar upon the technical applications of the phase rule.

W. H. WALKER.

DEPARTMENT OF ELECTRICAL ENGINEERING.

The progress of the Department has been in the directions referred to in my report of last year. The changed curriculum then referred to has now gone into effect as far as the third-year class. Graduate instruction is being provided for several students who are accepted candidates for the Master's degree,

and for one student who is an accepted candidate for the degree of Doctor of Engineering. I believe that this is a forerunner of much work of an advanced character which will be done by the Department, and that this may be expected to attract students who are capable of carrying on engineering research, through which the utility of the Department will be materially increased.

The fourth-year class is now twenty per cent. larger than the fourth-year class at this time last year. This fact and the needs of the advanced classes which must be provided with suitable rooms in which to carry on lectures, conferences, and seminars, emphasizes the need of one or more class-rooms which may be placed solely at the disposal of the Department. We cannot fully develop the work of research and the instruction of advanced students without having these additional facilities.

The effort to maintain intimate relations between the lectures, recitations, problem work, and laboratory work in the Department is continued with good results. The relations of the work of this Department to that of surrounding departments are reasonably satisfactory in most respects; but efforts are being constantly made to improve them for the sake of arriving at that co-operation which is essential to the most successful training of electrical engineers.

During last term Professors Laws and Shaad made an inspection visit of several days to Cornell University. The expense of these visits was generously provided for by Mr. Frederick P. Fish of the Corporation. Each of them made brief written reports to me of their observations, and I have transmitted abstracts thereof to the donor of the fund. I believe that such visits of inspection to other engineering schools maintaining high-grade electrical engineering instruction ought to be extended. The teaching staff of the Department is composed mostly of men who have made the teaching of electrical engineering and allied subjects their work since the time of their graduation from the Institute or some other engineering school, and it is of advantage to us to afford these men an

opportunity to compare by observation the methods of other important engineering schools with our methods.

It is equally important that the members of our staff should attend meetings of the professional and commercial electrical engineering societies, such as the American Institute of Electrical Engineers, the National Electric Light Association, the American Street and Interurban Railway Association. It seems to me that it ought to be fixed as a matter of policy that one or more members of our staff should be present at the annual convention of each of these important societies. Such a policy would unquestionably add fertility to the teaching of our undergraduate classes, and it may be considered one of our proper contributions to the formal efforts that are being made for the improvement of electrical engineering practice. Some members of our staff also ought to attend the meetings of the Society for the Promotion of Engineering Education for the purpose of comparing experience with engineering teachers from all parts of the country in regard to the processes of teaching and related subjects. It is impossible, however, to expect junior members of our staff to personally defray out of their small salaries the expense of attending one or more such meetings each year; and it is therefore desirable, either that a fund be made available to the Department from which the expenses of delegates to suitable conventions may be paid, or else that the salaries of the staff be raised with the expectation that voluntary attendance on engineering conventions will then follow to the needed degree.

Professor Clifford was elected a member of the Board of Directors of the American Institute of Electrical Engineers at the last election of that Society.

Mr. Waldo V. Lyon of the staff has published a book during the year entitled "Problems in Electrical Engineering," which is the outcome of his work in the Department and represents the character of problems used with our third-year classes. The book has received general commendation from the engineering schools and from other sources, and I hope that it may be the forerunner of several important books published by the staff.

:e relations of the staff with the students seem excellent; : would be desirable if more distinctly social relations could stablished. I do not know how this can be effectively : while the Institute is in its present location, with the stu- s and faculty so separated as to their living accommodations. he United States War Department has detailed a com- ioned officer of the Coast Artillery, Captain Clifton C. ter, to pursue a course in electrical engineering at the itute, to prepare himself for further teaching in the pro- ional schools connected with his branch of the service. tain Carter is an officer of experience who has served on ous important boards besides having been a teacher in the ool for Submarine Defence. He has already gained the 1 regard of the Faculty.

The needs of the Department are of the same nature as those forth in my report and estimates last year; but they are iewhat more critical now on account of the increased size of fourth-year class and the probability of a rapidly increasing nber of students pursuing advanced study and research. iong other things, it is very desirable for us to have a large m in which problem work related to the courses of profes- nal lectures on electrical installations may be executed on drawing board by fourth-year students.

One of the greatest needs of the laboratories is the formula- n of additional alternative experiments, so that the students the different sections may work upon different experiments ustrating the same principles. This improvement would ake the laboratory work more interesting, and would bring eater results as the men could compare notes and gain a der horizon in regard to manipulation and experimental ocesses than is possible to attain where all of the students go rough a series of substantially the same experiments. The rangement would also tend to afford an improved sequence of ork in the laboratories by allowing more elasticity in the signment of laboratory problems. These alternative experi- ents cannot be fully planned or carried out until we have

certain additional apparatus which I mentioned in my report last year, and the question of additional space (especially in the standardizing laboratory) is still pressing.

It would be highly advantageous to the electrical engineering students if the electrical books which are now housed by themselves in the Lowell Building were joined with the other books on engineering subjects, and the combined library were then located in a library and reading room conveniently situated for the use of the engineering students in all of the branches. This arrangement would also probably be of service to the students in the other engineering departments who are now deprived of the use of electrical books because of their location away from books on other engineering subjects.

The Department has received a number of gifts during the year. These include the money needed to defray the expenses of inspection trips to Cornell University already referred to, and the money to defray the expenses of three dinners of the Electrical Engineering Society at which Mr. H. G. Scott (President of the American Institute of Electrical Engineers), Dr. Charles P. Steinmetz, and Professor Elihu Thomson were respectively the guests of honor and addressed the Society. Mr. Charles L. Edgar of Boston presented the Department with a handsome framed photograph of Mr. Edison, in large size, which is now hanging in the reading room, and the Sangamo Electric Company presented meters of its manufacture.

DUGALD C. JACKSON.

DEPARTMENT OF BIOLOGY.

There has been for the last two or three years a marked increase in attendance upon the classes in bacteriology, industrial biology, sanitary science, public health, and municipal sanitation, more students from other Departments having resorted to these courses during the last year than ever before, while a gratifying increase in the number of graduate students in Biology has also occurred.

ıe degree of Bachelor of Science in Biology was awarded ıne to four candidates. Of these one has since become ndidate for the degree of Doctor of Philosophy and has awarded the Savage Fellowship; another was immediately ›inted assistant biologist to the Typhoid Fever Commission ıe city of Pittsburg; a third became resident bacteriol- : and chemist on the municipal water filtration plant of folk, Va.; and the fourth began preparations for entering official service of the United States Army.

he demand for our graduates, and even for well-trained ıial students of biology, has continued, in spite of the in- trial depression, far beyond the supply; and as this is a dition which has lasted now continuously for several years, ; greatly to be desired that some way be found of making opportunities which Biology offers for successful public vice more widely known.

\ number of interesting and important investigations have ın carried forward by the members of the teaching staff, ticularly in co-operation with advanced and graduate dents. Some of these have concerned the solving of prob- ns directly affecting the public welfare, and especially the blic health. By numerous public addresses, conferences, d recommendations, and by extensive and laborious corre- ondence upon questions affecting biological education and ıblic health measures, the members of the staff have also rther contributed to the service of the Commonwealth. hey believe that their duty to the Institute, to the State, ıd to the larger community which they serve requires of them ›und and wise teaching, careful investigation, and expert ıd helpful public service, and these to the best of their bility they have freely given.

The increase of students referred to above has brought bout in our various laboratories a serious congestion, which lready interferes with our work and in the near future will ıandicap it heavily. In my last annual report I drew atten- ion to this subject and to the pressing need of a special build-

ing for the Department of Biology, so that adequate laboratories, lecture rooms, museums, and the like might be provided. It is true that we have got on thus far fairly well without most of these things, but we have now come to a point when we shall be unable successfully to maintain the prestige of the Department, and especially to attract desirable graduate students capable of carrying on the most important investigations and performing the most useful kinds of public service, unless a special building can be provided. Under one roof we ought to be able to house comfortably and efficiently the entire Department and also the principal laboratories of the Sanitary Research Laboratory and Sewage Experiment Station now on Albany Street. We need a new and much larger bacteriological laboratory, with special provision for hygienic lighting and ventilation. We need—what we have never yet had—a large lecture room for the Department, and especially for the classes in sanitary science and public health, in industrial biology, in municipal sanitation, and in general biology. Owing to the seriously overcrowded condition of the Institute today large lecture rooms in convenient locations are scarce, and must be shared in succession by different departments,—an inconvenient and objectionable arrangement involving wasteful loss of time and energy. The library of the Department, representing the working accumulations of a quarter of a century, is so overcrowded as to be used only at a great disadvantage. Worst of all, there is nowhere in the Department any place for quiet, uninterrupted study; no place for rest, or even repose; no sense of either space or seclusion; and until we have such places the proper study of biology, of life and the right conduct of life, under hygienic and sanitary conditions must remain an ideal rather than a reality.

We need also acutely a working and teaching museum, not of mere bones or stuffed animals or dried plants, but of plans and models and devices for applied biology; for the purification of sewage and water; for the ventilation of houses

ıips and schools and cars; for the materials of biologi-
aching in every grade; for plans and photographs of
towns, model dairies, model factories, model houses;
emonstrating the data of evolution; for microscopes
ıicrotomes, and other indispensable biological apparatus.
ıeed a chart-and-model room for storage. We need
ı and consultation rooms in which to meet the ever-grow-
ıtream of students, visitors, and legitimate petitioners
ɔientific aid in important public service; and we need
completely separated from quiet and secluded private
atories in which, and in which alone, in a busy modern
ɔpolis, professors whose services are much in demand
he public can do any worthy investigation or fruitful
/.

ıe professors of the Biological Department believe that
.merican civilization becomes more widespread and more
thy, it also becomes more complex and more difficult;
the successful conduct of personal and community life
ɔecoming increasingly important, and ought to become
easingly scientific; and that questions of life and death,
ıealth and disease, of hygiene and sanitation, are coming
he front in the future as never before. They also believe
Biology, the science of life, is therefore deservedly receiving
ɔvery hand more and more attention, and that it is bound
'eceive yet more in the not distant future,—perhaps even
ɔming the most valued of the sciences. They believe that
central feature of the ideal scientific and technological
ɔol of that future will be a biological building of the sort
ɔribed above, in which life and health and disease and death
. the various problems of human efficiency and human
ɔpiness and human welfare shall be studied in the light
ıll the experience and all the learning and with all the aid
:he applied sciences of the time. For such a building and
maintenance the sum of $100,000 would suffice.

WILLIAM T. SEDGWICK.

SANITARY RESEARCH LABORATORY AND SEWAGE EXPERIMENT STATION.

In February of the present year still another gift of five thousand dollars, the sixth of like amount in annual succession, was received from the anonymous donor who has so generously contributed to the Institute thus far the entire cost of the equipment and maintenance of the Albany Street Laboratories for experiment and research in sanitation,—especially the purification of sewage, "by cheap and simple methods, before it is cast into rivers, harbors, or lakes." For the current year the amount hitherto contributed was increased by an additional sum of five hundred dollars. For these continued and liberal donations, and especially for the confidence implied in the additional gift just referred to, the Staff of the Laboratory and Experiment Station desire to express their renewed and profound gratitude.

The work of the first four years of the Experiment Station culminated, as stated in the last Annual Report, in the presentation of the outlines of a practical plan for the purification of Boston sewage, and the prevention of the pollution of the harbor by the Boston main drainage system. This plan was publicly presented before the Boston Society of Civil Engineers and afterwards extensively discussed either orally or in print by some of the leading sanitary engineers of the United States and by a prominent representative of English sanitary science. It was accepted for the most part as both practical and important, one engineer in Boston having written, "This illuminating piece of work alone has more than justified the expenditure of the small appropriation necessary to maintain the Experiment Station."

At about the same time there was published by the Staff the results of an elaborate series of tests of sewage distributors suitable for trickling filters, which proved of sufficient

portance to form the subject of a lengthy editorial abstract the *Engineering News* for January 9, 1908.

The actual work of the Station has again been under the mediate care of Professor C.-E. A. Winslow, Biologist in arge, with the able co-operation of Professor E. B. Phelps, search Chemist and Bacteriologist. Professor Winslow a recent report to the Director writes:—

'The work of the Laboratory and Station upon trick- g filters and the disinfection of sewage and sewage efflu- ts has attracted wide attention all over the country. In rticular the plan developed at the Station, largely through investigations of Professor Phelps, of disinfecting the luent of trickling filters with chloride of lime, has recently en adopted by the Sewage Commission of the City of Bal- more, in preference to other plans previously entertained, a very large saving to that city over the cost of all other plans.

"The special type of sewage distributor for trickling filters vented at our Experiment Station has been received with vor in many places and is now being installed, or is already operation, at sewage disposal plants as far apart as Min- sota, Canada, and Mt. Vernon, N.Y.

"Work has also been continued at our Albany Street Station r the purpose of fixing more accurately the optimum depth d kinds of material for beds of trickling sewage filters. The tails of the process of disinfection by bleaching powder have en worked out more fully and a new series of investigations s been started on the treatment of sludge from trickling ters in various forms of septic and hydrolytic tanks. An portant review of the whole question of disinfection by eans of chlorine has also been prepared by Professor Phelps d is already in press as a Bulletin of the United States Geo- gical Survey."

Professor Winslow continues:—

"The time has now come to put the work of the Sanitary esearch Laboratory on a broader and more permanent basis. Vork with our present Albany Street Plant can be continued

much longer only under serious limitations and disadvantages. At the same time any abandonment of the field occupied by the Sanitary Research Laboratory would be a distinct misfortune. By the work of the last six years the Laboratory and Experiment Station have attained a position of unique and almost national significance. It has even been said that many of the sanitary experts of the country are looking to the Institute for the most advanced and important investigations in the science of sewage treatment, and the reputation of the Institute in this direction in Great Britain and on the Continent is certainly flattering. Furthermore, the staff of the Laboratory and Experiment Station by its six years of experience has become trained to a high degree of usefulness in its special task. If our work on sewage treatment should stop, this reputation and this special training would soon be lost. If it is continued, the contributions of the Institute to the science and art of sewage purification should increase in value year by year."

The Officers of the Station greatly desire, and believe that it may be possible during the coming year, to secure a more favorable situation for the conduct of their investigations, as well as one in which the principal laboratory work could be brought within the walls of the Institute itself,—an arrangement eminently desirable from every point of view. With this possibility in mind Professor Winslow adds: "If a new plant can be obtained, as is expected, it is hoped that in the near future certain important phases of the question of purification on trickling beds, preparatory and final hydrolytic treatment, chlorine disinfection, sedimentation, and screening may be studied and settled. Moreover such a change as is now required would open up a new and important field of work in the possibility of a systematic study of sewage disposal systems for institutions, large and small, and for isolated houses. This problem deserves greater consideration than it has hitherto received; for in many respects the method of disposal adopted in these cases must be different from that available

arger installations having sewages of different character. resent the principles underlying the construction and op- on of such plants are not so well understood as they ought ɜ and some of the plants built to-day are foredoomed to re."

ofessor Phelps, in the course of a recent report to the ctor, says:—

n addition to the adoption of our sewage disinfection esses under my general supervision in Baltimore, I have been engaged by the State Board of Health of New Jersey port upon and design works for sewage disinfection plants ıat State, and by a firm in Philadelphia to design similar :s for another New Jersey community. A final report ı all these disinfection experiments both in Baltimore and oston has been prepared by me for the United States Geo- al Survey, in co-operation with which they have been made ur Sanitary Research Laboratory and at the Walbrook ing Station of the Baltimore Sewage Commission.

My report upon the disposal of sulfite waste liquors, also e to the Geological Survey and based upon work done at Station, will likewise shortly be issued."

ofessor Winslow has completed during the year under the ıices of the National Association of Master Plumbers specially important and exhaustive series of investigations he danger of the spread of bacteria through sewer air. earlier ideas of the promiscuous conveyance of disease 'sewer gas" were long since given up, but certain leading lish bacteriologists have recently published reports of in- gations indicating that, contrary to the current opinion, eria may nevertheless be transmitted somewhat readily neans of sewer air. Professor Winslow by careful quanti- e experiments has succeeded in showing that this danger ı slight as to be practically negligible. His investigations the more noteworthy not only because of their fundamen- and thorough character, but also because they harmonize erto discordant results, and particularly because the Insti-

tute was directly called upon by the National Association of Master Plumbers to do a piece of investigation which was only made possible and comparatively easy by the fact that it fortunately possesses a Sanitary Research Laboratory and Sewage Experiment Station.

It seems hardly necessary to point out once more the extreme educational importance of work of this kind as a demonstration, an example, and an incentive to our students of applied biology and chemistry and of civil and sanitary engineering. No other educational institution in America, and probably none in Europe, enjoys these particular advantages for practical studies in sanitary science. The only disquieting feature of our work is its annual uncertainty,—dependent as it has been thus far upon the beneficence of a single individual. We therefore earnestly appeal to all who realize, as we do, that "the first wealth is health," for a sufficient endowment to insure its permanency. The Institute can be trusted to administer it, to cherish it, and to maintain its efficiency.

WILLIAM T. SEDGWICK,
Director.

DEPARTMENT OF PHYSICS.

The changes which have been made in the instruction in the mathematics given to the first and second-year classes have made possible a better treatment of many of the subjects discussed in the lectures on general physics, because of which fact the whole Course is at present undergoing revision with this end in view. A revised edition of the "Notes on Mechanics," in use for many years, has been prepared by the writer; and a new collection of problems has been issued by Professor Drisko which covers the subjects of mechanics, electricity, and light. It is felt by the instructors that there is a distinct, though gradual, improvement in the knowledge of physics possessed by students on entering the Institute, and this makes possible a corresponding improvement in the results secured in our own courses.

ne of the most serious hindrances to increased success is
nduly large size of many of the sections for recitation. The
age number per section is too large for fully effective work,
the necessities of the tabular view cause so much inequality
livision that certain sections are very unwieldy. With
itional instructing force this difficulty could be remedied,
vided, of course, that recitation rooms are available to ac-
modate the increased number of classes. The new system
ndividual conferences, commenced since the opening of the
ent school year, gives promise of great benefit from the
e intimate relations which it necessarily established be-
en teacher and student.

The experiment begun several years since, of giving special
f courses of illustrated lectures with attendance voluntary,
order to discuss certain newer branches of physics more
ticularly than is possible in the required course, has proved
irely successful. A course upon Hertz waves and wireless
graphy was given for the first time in the second term of
year. This was attended by a large number of students
ose interest was maintained to the end of the term. A
rse of like character in polarized light is planned for the
umn of 1909. It is intended that each of these courses
ll be given once in two years.

The lectures in heat, fifteen in number, given to all students
the third year have been made somewhat more experimental
their character than was formerly the case. As there are
merous thermal processes and applications, however, which
highly important in certain branches of applied science,
ofessor Norton, who is in charge of this subject, has laid out
brief special course of technical lectures devoted particularly
such industrial applications of heat.

In the revised course schedules now in effect in the second
d third years the long desired arrangement of bringing the
boratory work into closer connection with the class room work
Physics has been effected for all courses except those in
ining and Chemical Engineering. The laboratory work

now begins at the middle of the second year and ends at the conclusion of the course in heat in the third year. An immediate result of this arrangement has been a much greater interest on the part of the students and far more effective work, to which the correlated class room instruction in precision of measurements now given at the beginning of the laboratory work has contributed in no small degree. The Department is very desirous that the time devoted to the laboratory may be increased for all courses by the addition of fifteen hours in the first term of the second year, in order to bring this work into still closer connection with the lectures and to make possible the introduction of a number of electrical experiments in connection with the lecture and class room work in electricity.

In connection with the general laboratory instruction Professor Goodwin has prepared and printed a brief treatment of the subject of precision of measurements and allied topics, and also a new part of his "Laboratory Notes on Optics." A new edition of the "Laboratory Notes on Heat" has also been issued.

An advantageous modification has been made in the Course leading to a degree in pure Physics in the arrangement of the study of theoretical physics, in charge of Dr. Daniel F. Comstock. There is now given a continuous course extending through the whole third and fourth years, beginning with dynamics, occupying a year, which is succeeded by a somewhat advanced course in electrostatics and electrokinetics. Courses in optics by Dr. Comstock and on energetics and the kinetic theory by Professor Goodwin are also given in the fourth year as heretofore.

Aside from the completed investigations, the results of which are embodied in papers already published (see p. 137), a research by Dr. Herbert T. Kalmus, still in progress, should be mentioned in this place. A study of the effect of the ultra-violet radiations of the cadmium spark, when this is of very great power, upon chemico-physiological action and bacterial growth has given results which promise to be of much importance

:n fully verified by longer experimentation. For these lies of Dr. Kalmus, the Zeiss ultra violet apparatus has n employed in connection with the powerful induction coil le for the Institute by Heinze of Lowell.

ıttention ought also to be called to the investigations regard- the physical properties of concrete throughout wide ranges temperature, which have been in progress in the laboratory heat measurements for a year past. This investigation cons a very important subject since it relates to the properties a new and important building material whose action under :at thermal changes is as yet little understood. The reırch referred to has been carried on by Mr. Armen H. Tashn, at present Assistant in heat measurements.

Much new apparatus both for lecture room and laboratory ›rk has been procured during the past year. A very conlerable addition has been made to the collection of vacuum bes, and much miscellaneous mechanical, acoustic, and ectrical apparatus has been procured, in part by purchase and part by construction in the workshop of the Department. In ırticular, the apparatus for illustration of the lectures on heat as been largely increased. Especially worthy of mention are lso several devices for the study of electric waves, those of ,echer and of Coolidge (one of our own graduates) for prouicing waves in wires. For generating electric waves in space n electric arc lamp of particular construction with needed ccessories has been designed by Mr. Eugene D. Forbes of our nstructing staff and constructed by the Department mechani:ian, Mr. Thomas Cloonan. This apparatus is particularly ntended for the investigation of wireless telegraphy and tele›hony.

An important instrument which will be of particular value to :he students in Mining and Geology is the Zeiss crystal reflectometer for the investigation of the optical properties of small crystals. This was purchased from the Katharine Bigelow Lowell Bequest. A Brace spectrophotometer has been ordered from Schmidt & Haensch, of Berlin, which will form

an important addition to the apparatus of the optical laboratory.

For the instruction in physico-chemical measurements the latest types of Beckmann boiling and freezing point apparatus have been added, together with apparatus for the determination of critical constants and dielectric constants. The extensive equipment for studies of this character is such that students electing this course have a wide latitude in the choice of work which they may pursue.

In the laboratory of electro-chemistry the most important additions made during the past year have been a new carbide furnace, a Sturtevant crusher, a thermit outfit, and a Féry radiation pyrometer, for the measurement of furnace temperatures. It is hoped that the power available for the work in applied electro-chemistry may be increased during the coming year. The limit of the 30 kilowatt alternator furnishing power to the laboratory has already been reached. With the rapid development of electro-chemistry more time each year is needed for laboratory instruction, especially in high temperature processes.

Our exceptionally extensive collection illustrating the various processes of color photography has received a large increase of lantern slides made by Professor Derr and presented by him to the Institute. These illustrate the new Lumiére and other processes not only as applied to ordinary subjects, but also in their application to micro-photography and to the reproduction of the chromatic phenomena of polarized light. Certain other slides are designed to illustrate the theoretical and practical limitations of color photography in its present stage of advancement.

Since the date of the last Report the Department has received several valuable gifts which are very fully appreciated. Among these should be particularly mentioned a fine compound microscope by Tolles with objectives and accessories from Dr. William Rollins, and also a Geryk air pump from the same donor. Professor Norton has presented to the laboratory of

ıt measurements, of which he is in charge, a Callendar elec-
: temperature recorder, which gives a continuous record of
;h temperatures, as, for example, those of a pottery kiln or
annealing furnace. This instrument, made by the Cam-
ıdge (England) Scientific Instrument Co., is the most deli-
ːe and beautiful of modern temperature registering devices.
There has also been received from Mr. George Wigglesworth,
:e Treasurer of the Institute, a generous gift which has
abled the Department to be assured of skilled assistance in
e preparation of the lectures, to the great advantage of
achers and students alike.

CHARLES R. CROSS.

DEPARTMENT OF GEOLOGY.

The two most important changes in the work of the Depart-
ıent of Geology in 1908 have been the rearrangement of geo-
›gical schedules for students of Civil and Sanitary Engineer-
ıg and the enrolment of an unusual number of graduate
:udents in geology, working for higher degrees. Of the lat-
ːr, one has been appointed instructor and another assistant
ı the Department, with the understanding that one-half of
heir working time be given to study and investigation. Three
ıf the graduate students are candidates for the degree of Doctor
ıf Philosophy. Advanced work in the petrographical lab-
›ratory has been carried on by Mr. George W. Edmond, who
pent seven months of the winter and spring in exploration
›f the wild desert region of Lower California north of the 29th
›arallel of latitude.

Mr. Waldemar Lindgren, M.E., Geologist in charge of the
ːections of Mining Geology and Metal Statistics of the United
States Geological Survey, has been appointed lecturer in Eco-
nomic Geology for 1908-09, to succeed Professor Kemp. He
has secured leave of absence from Washington for five weeks
in the late autumn; and during this time, while resident in

Boston, he will give a course of lectures and conferences on ore deposits and economic geology. His course will cover in a broad way the general outlines of the science of mineral deposits, except the hydro-carbons, and lay special emphasis on the mining development of the Cordilleran district. Parts of the work are to be exhibits of lantern slides and a weekly conference with the mining students who take the course.

Professor Jaggar completed during the year a report on the Technology Expedition to the Aleutian Islands in 1907, and published some preliminary papers on that work.

Professor Daly has spent a large part of the year in completing the preparation of the report on the geology of the trans-Cordilleran belt along the 49th parallel boundary between the United States and Canada. A large number of the new rock-analyses have recently been made, making the total number for this report sixty-one. The great value of these complete and accurate analyses has clearly indicated the desirability of there being provided in the Institute similar facilities for making rapid and complete analyses of rocks in connection with the other investigations now in progress in the Geological Department. The Department is still suffering from a lack of lantern slides for use in the various courses of instruction. A special fund, say $200 per year for five years, could be advantageously expended in procuring the slides which are most essential to the Department.

Professor Warren reports additions to the mineralogical and petrographic collections of several suites of rocks from well-known localities in Canada. He gave the summer to travel in various parts of Canada and New England, carrying on mineralogical and petrographic study partly in connection with the work of students and partly by way of making special collections for the Institute. It is to be regretted that, on account of lack of proper cases of drawers, much of this material is inaccessible for study. Professor Warren calls attention to the need of more time for laboratory work in mineralogy, in order that our students of Mining

may acquire a more thorough knowledge of minerals, and to this end urges the holding of a required summer school in surveying between the first and second years in order to relieve the winter schedule of studies. He further calls attention to the great and increasing importance of the science of petrography for students of Mining, all of whom should acquire at least a rudimentary technical knowledge of the common rocks. In this connection it may be said that many advantages would result from a merging of Options I. and III. in the Mining Course; and it is to be hoped that the proposed requirement of summer work will make the distinction between the two Options thereafter unnecessary.

Professor Crosby has continued his work as geological expert in several important branches of the public service.

Professor Shimer reports important additions to the collection of fossils. During the summer Professor Shimer continued work on the book which he is writing jointly with Professor Grabau on North American Index Fossils. During the autumn he took voluntary excursions to places near Boston, in order to study recent and fossil animal life. These expeditions were well attended by students, the average number being eighteen. Professor Shimer strongly recommends the establishment of a field summer school in geology. Other large mining schools demand such field work. Most of the mining students of the Institute get some summer experience in practical mining; but they have small opportunity to study the geology of the mining districts in question and no practical study of fossils in the field. If some region could be found, such as Southern Ontario, where combined work in mining, geological field mapping, and identification of strata by fossils could be done from a single central camp, a school organized for the purpose would be invaluable to the students of the Mining Course.

Mr. Charles H. Clapp, Instructor in geology, is investigating the relations of the igneous rocks of Essex County, Mass. During the summer of 1908 he made, for the Geologi-

cal Survey of Canada, a geological and topographic reconnaissance of the south-eastern portion of Vancouver Island, the area explored including the Mt. Sicker copper district. A preliminary report of the work done will be published in the Summary Report of the Director of the Geological Survey of Canada for 1908. Dr. Gerald F. Loughlin has during the past year assisted in the instruction given in geology at Tufts College and Boston University. He has assumed, with Mr. Clapp, the work of compiling a bibliography of "Economic Geology"; and he has accepted the position of reviewer of American petrographic papers for the Geologisches Zentralblatt. Mr. John A. Allan, a newly appointed assistant in the Department, and Mr. Charles Camsell, a graduate student, were together engaged in exploration for the Canadian Geological Survey in the Similkameen Valley of Southern British Columbia.

The Department is indebted to Mr. Arthur Winslow, '81, for the gift of many sets of scientific periodicals and government reports, which constitute a valuable addition to the departmental library. The seismograph provided by the Trustees of the C. A. R. Whitney Estate and constructed by the firm of J. and A. Bosch in Strassburg, Germany, was delivered in Boston in November, 1908.

THOMAS A. JAGGAR, JR.

DEPARTMENT OF NAVAL ARCHITECTURE.

The Department of Naval Architecture, though the most recently established, has now been in operation for fifteen years. During that time, the Course has been so far developed and the equipment so far completed that changes and additions for such a period as one year may be only of minor importance. Such is the case for the year just passed. During the last year, however, a notable change was made in the curriculum of study for this Course, which is now in progress. Mention

may again be made of the addition of a torsion-meter to our equipment. This has enabled us to undertake a very important test on the steamship "Harvard" of which a recent report has been made to the Society of Naval Architects and Main Engineers. This test and that reported last year on the steamship "Governor Cobb" give us an established position along this new line of engineering development, comparable to that which we have attained for the older type of steamer. Meanwhile, the development of steam-turbine work in connection with our course in marine engines gives us a corresponding leading position on the theoretical side. As showing the interrelation of departments at the Institute, this development in our Department has made it possible to offer an Option in steam-turbine engineering in the Course in Mechanical Engineering.

Through the interest of a friend of the Institute lectures have been given every year by eminent men in the profession. This year, in addition to other lectures, a course will be given during the month of April, by M. Bertin, Directeur de Construction Navale (en retraite) au Ministère de la Marine Française. M. Bertin is not only a leading authority in his profession, but a distinguished lecturer, and his wide experience in connection with governmental and private work is sure to make this course one of unusual interest.

The Department has recently received the professional library of Admiral Philip Hitchborn, U.S.N., former Chief Constructor. The distinction of the donor and the importance of the books make this gift a valuable addition to our library.

C. H. PEABODY.

DEPARTMENT OF MATHEMATICS.

The period covered by the present Report has been characterized by continued progress in the remodelling of our general mathematical course, and by a considerable number of changes in the personnel of the Department.

With the present second-year class we are using in pamphlet form the earlier chapters of Woods & Bailey's Course in Mathematics, Part II. These chapters are devoted mainly to methods and applications of definite integrals, including the mean value of functions, areas bounded by curves, length of curves, volumes of certain solids, and various applications to mechanics, including work, attraction, pressure, and centre of gravity. It is expected that the remainder of the second volume will be ready in March. The advantages of the new program have, so far as can be judged from experience up to this time, fully justified the very considerable labor involved in working it out. Incidentally it has naturally been necessary to make special provision for graduates and students from other colleges securing admission to the second year without preparation in that part of the calculus now taught in our first year. Special supplementary lectures on the differential calculus have been given to these students outside of the regular tabular-view hours.

The changes of personnel referred to include the resumption of teaching by Professor Bartlett after two years' service as Acting Secretary of the Institute; the return of Dr. Moore from a year's leave of absence spent with much profit in geometrical studies at Turin; the resignations of Instructors Miller, Roever, and Lennes, and the appointment of Mr. Joseph Lipke to the same grade. Mr. Miller is now engaged in private business; Dr. Roever has been appointed an assistant professor at Washington University, of which he is a graduate; and Dr. Lennes is instructor in Brown University. All three men had rendered excellent service in the Department. Mr. Lipke comes to us as a graduate of Columbia University, after a year of valuable teaching experience at the University of California. In connection with this appointment it may be noted that the twelve persons now teaching in the mathematical department hold degrees from eleven different institutions, only two being graduates of the Institute. While an appointment policy so antithetical to "in-breeding" may be attended with certain

difficulties in securing the necessary co-ordination of methods and points of view, the variety in itself has proved stimulating, and the difficulties have been met by free discussion of matters of common interest in the bi-weekly department meetings which have been held since 1902.

H. W. TYLER.

DEPARTMENT OF DRAWING AND DESCRIPTIVE GEOMETRY.

During the last year a slight change was made in the instruction of the first-year students, Mr. Burrison giving the lectures in descriptive geometry in Huntington Hall. Although the number of students passing in the subjects of mechanical drawing and descriptive geometry was not markedly different from the preceding years, it is safe to say that the quality of the work of those who did pass was considerably improved.

At the close of the year Mr. Bradley and Mr. Kenison were promoted by the Corporation to the rank of Assistant Professors; and Mr. Sawyer tendered his resignation as Instructor in Freehand Drawing. It was found possible, by means of some rearrangement of the work and by the fact that Professor Adams and Mr. Bradley were now free to give a larger portion of their time to teaching, to continue the instruction for the coming year without replacing Mr. Sawyer.

The second part of the text-book in descriptive geometry is now ready for use by the students. The Department has been greatly in need of a suitable text-book on this subject, in order that the students might have a chance to study it in addition to the lectures. We now feel that we have, in the text-book in mechanical drawing, and in the two parts of the descriptive geometry, books which practically cover all the lectures given in the first year.

There were frequent Department conferences throughout the year, and among other things discussed was a plan for a radical

change in the teaching of the mechanical drawing and descriptive geometry. This change consists chiefly in the division of the class into four sections, each of which is to be assigned to an instructor who shall have entire charge and responsibility for the students assigned to him. The whole work, however, is to be under the general direction and supervision of one man. In order to make this plan a success it will be necessary to have four drawing rooms, each of which can be reserved for the exclusive use of one section. By this division of the work a greater incentive is given to the younger instructors to keep their men up to the standard. The comparison of the different sections will be made at the end of each term by an examination given by the man having general oversight of the work. It will also be possible under this arrangement to make the classes for one man smaller than they have been in recent years. It has been found by experience that personal instruction given at the drawing table is more valuable than the instruction given from the lecture platform. A plan for the arrangement of rooms on the fourth floor of the Rogers Building has been submitted to the President for his approval, and it is hoped to begin this work next year. It would have been undertaken at once had it not been for the expense and time necessary to fit these rooms up as suitable drawing rooms. In this way it will be possible to create a greater interest in the instruction among the younger men of the staff, and to produce a higher percentage of good work among the students; for, while descriptive geometry is not an exceedingly difficult subject as compared with some of the mathematical courses, it is a subject of an entirely different character from those which have been followed by the students before entering the Institute, and there is a greater difficulty in starting new men in this work than is encountered in any other first-year subject.

ALFRED E. BURTON.

DEPARTMENT OF MECHANIC ARTS.

The total number of students receiving instruction in the Mechanical Laboratories is two hundred and seventy-one. Some of these attend in more than one class, the numbers in the several subjects being as follows:—

Subject.	*Course.*	*Students.*
Carpentry and Wood Turning	II.	62
Joinery and Pattern Work	VI.	33
Forging	II. and XIII.	81
Metal Turning	VI., VIII., and X.	56
Chipping and Filing	II. and XIII.	60
Machine Tool Work	II. and XIII.	54
Total in all classes		346

The total number of students attending last year was two hundred and eighty-six. Many students from mechanic arts high schools have been excused from attending the carpentry, wood turning, and forging classes, and some from pattern work. The number of excuses granted in these earlier subjects is still increasing, but is not yet sufficiently large to warrant omitting the elementary and giving only the advanced wood work. It is believed that it will be advisable to provide advanced work in the wood-working department in the not far distant future.

Summer School.—The attendance in the Summer School was 46, a decrease of 20 as compared with last year. The numbers attending in the several classes were: wood work, 13; forging, 3; chipping and filing, 4; metal turning, 5; machine tool work, 16.

The proportionately large attendance in the machine-tool work continues, due to the desire of many students to anticipate the mechanic arts of the Senior year and thus obtain additional time for thesis and other departmental or allied work.

Equipment.—The following new machines and apparatus have been added to the equipment in the Machine Tool Laboratory:—

A Lucas power forcing press, a Gisholt universal tool grinder, a show case of emery wheels from the American Emery Wheel Works of Providence, R.I., and a case of Alundum wheels from the Norton Company of Worcester, Mass.

In addition the following new machines have replaced old ones: one Reed engine lathe with compound rest and taper attachment in the lecture room; five Reed engine lathes in the laboratory.

The prices on the above-mentioned machines were made very liberal, a considerable portion of the usual trade prices being donated by the manufacturers.

To maintain the required high standard of work in the Machine Tool Laboratory seven engine lathes, five speed lathes, and a planer purchased in 1876 should be replaced with modern tools. A small radial drill and an additional universal milling machine are also needed.

The installation of an automatic screw machine would permit adding instruction in the operation of automatic machines to our course.

Some of the equipment in the Wood Working Laboratory, in use since 1877, should be renewed. The addition of a few larger lathes and a surface planer is also desirable.

The equipment of the Forging Laboratory is now nearly worn out and can be kept in proper condition but a few years longer. Six new anvils were added last year, and the sheet metal work about the forges was repaired. Thirty-two new tool benches are much needed. So much of this equipment is of a fixed character that it is inadvisable to renew the same in case the laboratories are to be moved in the near future.

The Foundry equipment must be repaired and a new and larger cupola furnace should be installed before the opening of next year.

The quarters vacated by the old Technology Union have been given to the Department. This space will be utilized for an extension of the filing laboratory; for instruction in pipe fitting, which relieves much needed space in the machine-tool

laboratory; for a lecture room; and for machinery illustrating the use of pneumatic tools, which it is hoped soon to install.

Building.—The building is in fair condition, but new floors are advisable in the machine-tool and wood-turning laboratories, the present floors being too unsteady for good machine work. The lighting is not sufficiently good to enable exact work to be done, and the present inadequate gas-lighting system, installed in haste in 1884, should be replaced by a modern electric system.

PETER SCHWAMB.

DEPARTMENT OF ENGLISH.

In the Department of English the changes of the year have been mainly in the line of endeavors to improve methods already in operation and to render them more effective. The division of classes into small sections is made more difficult by the increasing number of students in successive classes; but this has been in part balanced by the exchange of an assistant giving but half time for an instructor whose whole time is available. The conference work has been constantly increased and improved, and is proving of the greatest practical value. In both first and second-year English new plans and methods are tried each year, at once for the sake of finding the best and of keeping the instructing staff alert and interested.

The most serious need of the Department is that of more time. Within recent years an advance has been made in this direction, but it is strongly felt by all the English instructors that in each term of the first and of the second year should be a 30–30 course in composition or literature. A most important step in this direction was made when a 30–0 course in rhetoric was put into the second term of Freshman year; and another advance was made when in the first term of Sophomore year the Courses in Civil, Mechanical, and Sanitary En-

gineering and in Naval Architecture were advanced from 15–5 in English literature to 30–30. The time in the first instance should be doubled, and in the second the arrangement should be extended to all courses. The readjustment which must soon be made of released time should provide for these needs in English.

ARLO BATES.

DEPARTMENT OF ECONOMICS.

The efforts of the Department during the past year have been in the direction of closer supervision of individual work. Conference work in general political economy has been emphasized more and more each year. For example, during the first half-year Professor Doten met 234 men for conferences of from fifteen to twenty minutes each, by special appointment. This work has proved very helpful in clearing up individual difficulties which could not be so well handled in lectures or recitations. It seems desirable to continue this plan, although it involves a great amount of labor.

In the special subjects of the second half-year the personal contact between student and teacher is maintained by means of laboratory methods in investigating special problems. Under this plan the classes in banking and finance, railroad economics, labor problems, etc., are divided into small sections for the third hour of the week, and each section works in the library or class room under the direct supervision of the instructor.

DAVIS R. DEWEY.

DEPARTMENT OF MODERN LANGUAGES.

)uring the past year the work of the Department has been ried on in accordance with the plan set forth in the Catae, except that elementary German, not included therein, been offered with the approval of the Faculty. The subs taught and the number of students taking each are shown the following table:—

Subject.	*Sections.*	*Students.*	*Average Size of Section.*
Italian	1	1	1
French II.	9	198	22
French IIIA	1	7	7
French IIIB	1	22	22
French Colloquium	1	19	19
German I.	2	63	31.5
German II.	11	174	15.8
German III.	1	22	22
German IIIB	1	19	19
German Colloquium	1	28	28
Spanish I.	2	32	16
Spanish II.	2	7	3.5
Spanish III.	1	10	10
	34	602	16.7

Number of students taking French	246
Number of students taking German	306
Number of students taking Spanish	49
Number of students taking Italian	1

A comparison of this table with the corresponding one of t year suggests the following comments:—

1. The total number of students taking modern languages only five less than it was last year.

2. The size of the average section has increased from 16.2 16.7. The most effective instruction is given in sections from 10 to 12 students. Fifteen is considered a proper aximum. At present, there are 5 sections that number ore than 25 students and 2 that number more than 30.

3. Three courses are given that were not given last year,

Spanish III, French IIIB, and German IIIB. This is the first year in which the last two courses, especially provided for students of Course VI., have been offered. Esperanto is offered for the first time, to begin with the second term.

4. The number of students taking elementary German has increased from 39 to 63. It seems probable that the number will further increase as it becomes more widely known that this subject, though not in the Catalogue, is given at the Institute. This raises the question whether the course had not better be announced hereafter in the Catalogue or the offering of it absolutely discontinued.

A large number of students desired to take Spanish, if they could be credited with it as a third-year option, but could not afford to do so if they had to take the option as an extra subject. The practical prohibition of the study of Spanish to regular students, not having advanced standing, appears to be felt especially in the Course in Mining. Students of this Course commonly look forward to working in Spanish-speaking countries, and seem to appreciate the hopelessness of finding a Spanish-American who can and will do business in English.

The Department experimented during the past year with the system of conferences, and would have used it extensively this year had not the force of the instructing staff been reduced.

The condition of the Department, so far as I am able to judge, will compare favorably with that of similar departments in other colleges of the country; but it is not what it might and should be. The Department would be much improved by the following innovations:—

1. Change of time distribution for the students, from 3 hours of class-room exercise and 6 hours of preparation, to 4 hours of class-room exercise and 5 hours of preparation per week. The present distribution is antiquated and wasteful.

2. Oral tests at entrance examination. The proper teaching of a language, whether for reading or for speaking, depends

ıpon a certain familiarity with the sound of the language. This ought to be the first thing imparted to the student. Our nstructors should not have to teach our students, as they now lo, the sound of the French alphabet.

3. A sufficient number of instructors to keep the size of the ıverage section down to 15 students, to provide for conferences, and to admit of the change of time distribution already ıuggested.

4. Administrative measures that would secure for the modern language instruction more than it now has of the time ıominally assigned to it. The optional courses in modern anguages are not fairly started until about two weeks after he commencement of the term. Towards the end of the erm students absent themselves more or less from modern language exercises to prepare for examinations in other subjects. Throughout the term they are commonly late or absent because they have been kept at shop work or assaying up to the end of the preceding hour or later, and then have had to wash or change their clothes. Moreover, interference sometimes results from subjects that are neither announced in the Catalogue nor provided for in the Tabular View. Thus, at the beginning of a term, at the end, and in between, the Department loses much time that would seem to belong to it. It is desirable also that hours assigned to modern languages in the Course for Naval Constructors be embodied in the Tabular View, and that three hours be reserved weekly for exercises in third-year general studies. There was but one hour reserved this term, leaving two to be determined from Tabular View cards, Having a number of courses to arrange in this way after the beginning of each term, I should appreciate anything that might be done to diminish the labor which it involves, and the consequent delay in the commencement of the term's work.

For the cutting of recitations towards the end of a term, two remedies suggest themselves: a strict adherence to the requirements in modern languages, especially for graduation, and a general abolition of final examinations.

The summer reading of last year in foreign languages, with the number of books to every ten students since this work was instituted, is shown in the following table:—

Year.	No. of Reports Received.	No. of Foreign Books Read.	No. to every Ten Students.		
			1906.	1907..	1908.
First	182	31	1.17	1.22	1.70
Second	179	29	1.29	1.34	1.62
First and second . . .	361	60	1.23	1.27	1.66

Mr. Dike has rendered a report on his observations of modern language teaching in France. Copies of this report have been furnished to all instructors in the Department for their perusal and consideration, and a meeting has been called for a general discussion of it. The idea suggested of avoiding the use of English in the class room is no new one to us. We have fully discussed it, and, while not in perfect, are in substantial accord as to its advantage and feasibility.

Mr. Dike informs us that the reform of modern language teaching in France came "from above," and remarks that at the Institute not half of its result can be obtained "for to a large extent the method of teaching is dictated by that of the preparatory schools, and in these the method of teaching by translation is hereditary." He probably does not mean to imply that the preparatory schools are primarily responsible for the backward state of modern language teaching in America, which in my judgment would be doing the schools a serious injustice. The method of teaching by translation is not as hereditary with them as it is with the colleges. The work of the schools consists largely in preparing pupils for college. If the colleges do not recognize oral language as of any value, giving their students no credit for it, how can it be expected that the schools will give any appreciable attention to it? The Modern Language Association of New England, composed for the greater part of school teachers, has expressed itself clearly and emphatically in favor of an oral test for college entrance. The Modern Language Association of America and the College Entrance Examination Board are now taking

he matter up. All this is due to the influence of the preparatory schools. For years the colleges, especially the larger and older universities, with their traditional disdain for the utilities, have sat like an incubus upon the comparatively young, progressive, and practical preparatory schools. The needed reform is coming, I believe, with us, not from above, but from below.

The work of Dr. Hermann A. Schumacher, exchange teacher from Germany, deserves special mention. In accordance with the original announcement by bulletin Dr. Schumacher has given a number of weekly talks for students registering therefor, which all members of the instructing staff of the Institute were invited to attend. I have attended a number of these talks. It is perhaps too soon to judge of their value to the Institute. Students attending them appear to be interested, and I judge therefrom that they understand and follow the lecturer. There is little or no conversation. The topics covered thus far are German Schools and Universities, the German Army, and the German Government. The attendance has averaged about twenty-eight students.

JOHN BIGELOW, JR.

The Society of Arts.

The report of the Executive Committee of the Society of Arts of a year ago entered somewhat at length into the purposes of the Society and its relation to the Institute and the public.

During the past year twenty-one members have been dropped for non-payment of dues, nine have resigned, chiefly as the result of persistent efforts to collect dues in arrears, one has died, and two have been elected to membership. There are at present two hundred and ninety-four associate members, forty-six of whom have paid twenty or more annual assessments, and are entitled to the benefits of life membership without further payment of dues.

The attendance at the meetings has been fairly good: eighteen was the smallest and two hundred and twenty the largest audience, with fifty or sixty a fair average.

There were thirteen meetings during the winter, with talks on the following topics:--

"Chilled Car Wheels." By Mr. F. A. Beebee, Assistant Manager of the Griffin Wheel Company, Chicago.

"The Grand Canyon District." By Professor Douglas W. Johnson, of Harvard University.

"Refrigeration." By Mr. Norman H. Cheney, Chief Engineer of the Merchants Cold Storage & Freezing Company, Providence.

"Forestry." By Mr. Phillip W. Ayers, State Forester of New Hampshire.

"Denatured Alcohol." By Rufus S. Herrick, Chemist, of Boston.

"Ascents of Orizaba and Colima, two Mexican Volcanoes." By Professor John E. Wolff, of Harvard University.

"The Evolution of Bogoslof, a new Volcano in Behring Sea." By Professor Thomas A. Jaggar, Jr., Institute of Technology.

"The Curtis Steam Turbine." By Mr. Charles B. Burleigh, of the General Electric Co., Boston.

Recent Developments in Fire Protection Devices." By Mr. Gorham
a, of Boston.
The Lumière Autochrom Plates." By Mr. J. E. Brulatour, of the
nière Co., New York.
The Deflocculation of Non-Metallic Amorphous Bodies, with Special
erence to Graphite as a Lubricant." By Mr. E. G. Acheson, Presi-
t of the Acheson International Graphite Co., of Niagara Falls.
Factors Governing the Rates of Public Service Corporations and the
ernment Control of Rates." By Professor Dugald C. Jackson, In-
ite of Technology.
The Quebec Bridge Disaster." By Professor George F. Swain, Insti-
: of Technology.

For the Executive Committee,

EDMUND H. HEWINS, *Chairman.*
WALTER S. LELAND, *Secretary.*

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ARTHUR A. NOYES.—Address to the Graduating Class of the Massachusetts Institute of Technology. Printed separately. 1908.

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C. FRANK ALLEN.—Technical Education for the Profession of Rail-oading. *Railroad Men*, December, 1908.
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GEORGE E. RUSSELL.—Notes on Hydraulics. Revised and enlarged dition. Boston. 1907.
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GENERAL STATEMENT

OF THE

RECEIPTS AND DISBURSEMENTS

BY THE TREASURER

FOR THE YEAR ENDING SEPT. 30, 1908

Report of the Treasurer.

To the Corporation of the Massachusetts Institute of Technology:

I have the honor to submit herewith statements showing the financial condition of the Massachusetts Institute of Technology as of September 30th, 1908, and all transactions for the fiscal year ended on that date.

Particular attention is called to the comparisons of income and expense for the past twelve years, given on pages 22 and 23.

The following gifts and legacies have been received during the year, and call for the sincere thanks of the Institute:—

GIFTS, BEQUESTS, ETC. 1907–1908.

M. I. T. Alumni Fund Committee		$35,701.41
Charles G. Weld Fund, for general purposes		15,000.00
Lyman F. Rhoads Estate. "Bursar's Fund"		6,000.00
Anonymous donor, through Dr. Noyes, toward New Technology Union Building	$4,000.00	
Donor, "not to be made public," toward New Technology Union Building	500.00	
F. R. Copeland, toward New Tech Union Building	250.00	
C. C. Jackson, " " " " "	250.00	
Everett Morss, " " " " "	250.00	
Henry Morss, " " " " "	250.00	
Eben S. Stevens, " " " " "	250.00	
Joseph P. Gray " " " " "	100.00	5,850.00
Donor, through Prof. W. T. Sedgwick, for Sanitary Research Fund,		5,500.00
John C. Haynes Estate, general purposes		5,000.00
Dr. A. A. Noyes, for Physico-Chemical Research Laboratory		3,500.00
Charles G. Weld, for Naval Architecture Department		1,467.11
Thomas Gaffield Estate, additional		1,300.00
Charles W. Hubbard, for Research Laboratory of Applied Chemistry, first payment 3 years		1,000.00
J. H. Atwood, Melrose, Mass., a Starratt Pump for the Mechanical Engineering Laboratory valued at		500.00
Arthur Cary		500.00
Guy Lowell, toward Travelling Scholarship in Architecture		500.00
Charles J. Paine, for Naval Architecture Department		467.11
Mrs. Mary G. Pickering, 1 pr. Projection Lanterns, 1 pr. adjustable Rheostats, 2 Metal Slide carriers for use in Huntington Hall		230.85
Mrs. Wm. B. Rogers, for periodicals and magazines		225.00
Estate of Caroline A. R. Whitney, for benefit of Women Students		200.00

Francis Blake, toward purchase of Turbine, M. E. Department	100.00
Eben S. Draper, " " " " " "	100.00
H. F. Mills, " " " " " "	100.00
James P. Tolman, " " " " " "	100.00
Babcock & Wilcox Boiler Company, Gift, through a substantial reduction in the price of boilers.	

The contribution of funds for the current expenses of the Institute received through the Alumni Income Fund Committee continue to be of great assistance to the Institute. As was the case last year, not all of the money contributed from this source has been used for current expenses, but a substantial portion has been applied to permanent equipment. The construction of the new Technology Union has been made possible by an appropriation from these funds supplemented by generous donations from graduates and friends of the Institute. From the amount carried forward from last year's receipts from the Income Fund Committee and the amount since contributed a total sum of $41,809 has been appropriated by the Executive Committee during the past year for the following purposes:—

For one-half the cost of erecting and equipping the new Technology Union	$8,500.00
For installing new boilers and improving the heating and power plant	9,750.00
For fittings and installation of the new steam turbine	2,690.00
For steel testing machine for Mechanical Engineering Laboratory,	500.00
For equipment of the extension of the laboratory of analytical chemistry	650.00
For maintenance and improvement of Athletic Field	1,600.00
For providing for personal conferences between first-year students and instructors	1,600.00
For increase of salaries of the instructing staff	16,600.00
Total	$41,890.00

The Walker Memorial Fund now amounts with accrued interest to $116,388.40.

Respectfully submitted,

FRANCIS R. HART,

Treasurer.

84 STATE STREET, BOSTON, November 30, 1908.

FRANCIS R. HART, Esq.,
Treasurer Massachusetts Institute of Technology.

Dear Sir,—According to your request I have made a careful study of the Bursar's books and accounts and of the form of the Treasurer's annual report. After due consideration I recommend the form of report submitted herewith, which comprises the following schedules:—

First. A summary of the cash receipts, payments and balances of the fiscal year, October 1, 1907, to September 30, 1908.

Second. A summary of income and expenditure for the year. This summary exhibits the receipts from income under three heads: (1) "Income available for general purposes"; (2) "income available only for special purposes"; and (3) "income added to capital of funds." Corresponding subdivisions are exhibited in expenditure, namely: (1) current expenses from income; (2) special expenses from special income; and (3) additions to capital of funds.

Third. A summary of capital receipts and payments. The receipts from capital sources are set forth under four heads: (1) from "gifts and bequests on capital account"; (2) from "securities matured or sold"; (3) from "loans"—notes receivable which were paid by the borrowers; and (4) from fees and deposits in advance. Capital payments include: (1) "securities bought"; (2) loans on notes-receivable; notes-payable paid; and (3) expenditure for new buildings and equipment.

These receipts and payments are supported by detailed schedules on the pages mentioned.

Fourth. An "income and expense" statement (pp. 6 and 7) exhibiting the various sources of income available for paying current expenses, supported by subsidiary tables (pp. 10 and 11) which give further details of income and of expenses compared with corresponding items of the previous year.

In this income and expense schedule the income items represent actual cash receipts which pertain only to the fiscal year 1907–08, while the expense items include cash payments and also audited bills pertaining to the year, which were unpaid when the cash was closed at the end of the year, September 30, 1908. The "excess of expense," $23,131.91, exhibited in this schedule is identical with the net decreases of assets or increases of liabilities during the year as shown on the balance sheet, page 17. A comparison of similar losses (deficiencies of income) for the past twelve years is given on page 23.

Fifth. A balance sheet of September 30, 1908, covering three double pages and exhibiting: (1) securities and other assets; (2) funds and other liabilities; (3) book values of "educational plant"—which are in great part merely nominal values, many of the items having remained on the books at the present figures for twenty years or longer; and (4) the balancing account, heretofore called "M. I. T. Stock" account. The items on this balance sheet are given in full detail, with securities and funds arranged alphabetically in groups, and represent all of the open accounts upon the Treasurer's general ledger at the close of business September 30, 1908.

I recommend that the accounts for the new year be opened upon new ledgers according to this arrangement, funds being kept in a subsidiary "fund ledger" and investments in a subsidiary "investments ledger," each with a summary controlling account in the general ledger only.

Sixth. A statement of the various funds as they stood on September 30, 1908, compared with the corresponding balances September 30, 1907, together with the respective increases of these funds from income, or other sources, and the respective decreases of the funds from payments from scholarships, fellowships, awards, general purposes, etc.

Seventh. A comparison of income and expense as set forth in the Treasurer's cash accounts in his reports of the past twelve years. The year ending September 30, 1908, is included in this comparison with the items arranged according to the classification of previous years. The total income by this comparative statement, $517,878.32, may be reconciled with the total exhibited on "income" statement, $494,630.98 (p. 6), by the following items: Chemical breakage receipts. $12,964.68, deducted from total breakage; receipts from sale of lecture notes. $2,254.26, deducted from printing; income of funds for special purposes, $8,028.40, set up as "special expenses." The total of payments on page 7 differs by the same amounts and is reconciled in the same manner.

Very respectfully,

HARVEY S. CHASE,
Certified Public Accountant.

MASSACHUSETTS INSTITUTE OF TECHNOLOGY. TREASURER'S STATEMENT.

SUMMARY OF CASH RECEIPTS AND PAYMENTS.

OCTOBER 1, 1907, TO SEPTEMBER 30, 1908.

Cash balance October 1, 1907	$29,898.22
Total cash receipts, per cash book	774,510.89
	$804,409.11
Total cash payments, per cash book	721,554.16
Cash balance September 30, 1908	$82,854.95

Cash Balance September 30, 1908.

Cash in Banks	$71,644.64
Cash in Office	11,210.31
Total	$82,854.95

SUMMARY OF INCOME AND EXPENDITURE.

Income.

Income for general purposes (schedule, p. 6)	$494,630.98
Income for special purposes (schedule, p. 8)	23,632.88
Income added to capital of funds (schedule, p. 9)	5,735.74
	$523,999.60
Deficiency of income for general purposes (schedule, p. 7)	23,131.91
	$547,131.51

Expenditure.

For general purposes (schedule, p. 7)	$517,762.89
For special purposes (schedule, p. 8)	18,630.88
Total added to capital of funds (schedule, p. 9)	10,737.74
	$547,131.51

SUNDRY CAPITAL RECEIPTS AND PAYMENTS.

CAPITAL RECEIPTS.

From Gifts and Bequests on capital account (schedule, p. 20)	33,150.00
From Securities matured or sold (schedule, p. 20)	55,125.00
From Loans paid by borrowers	1,116.66
From Fees and Deposits in advance	87,890.00

CAPITAL PAYMENTS.

For Securities bought (schedule, p. 20)	71,432.50
For Loans made ($800) and notes-payable paid ($19,034.75)	19,834.75
For New Tech Union Building, payments to September 30	8,834.42

INCOME AND EXPENSE, 1907-08.

INCOME.

AVAILABLE FOR GENERAL PURPOSES.

From Students' Tuition Fees, 1907-08	$318,394.10	
From Scholarship Fees from Funds	20,787.50	
From Scholarship Fees from State of Massachusetts,	4,000.00	$343,181.60
From State of Massachusetts, gift		25,000.00
From United States grant of 1890		11,666.67
From United States grant of 1862		5,306.68
From Rents, net. (detailed schedule, page 10)		8,985.92
From Interest on Deposits, general		3,295.59
From Gifts, available for Special Salaries, etc. (p. 10)		2,425.00
From General Investments	$82,434.59	
Less: Credits to various funds $61,257.80		
Charges to reduce premiums 2,865.50		
Annuity, Samuel Dorr 1,000.00	65,123.30	
Remainder, available for General Purposes		17,311.29
From Income of various funds, transferred to General Purposes		24,491.82
As follows:—		
James Fund	$6,546.17	
Randall "	3,338.09	
Perkins "	2,000.00	
Dorr, G. B., Fund	1,982.94	
Richardson "	1,495.15	
Saltonstall "	1,280.13	
Edwards "	1,200.00	
Choate "	1,000.00	
Thayer "	1,000.00	
Rotch Architectural Fund	1,000.00	
Dorr, S. E., "	771.54	
Nash "	400.00	
Bartlett "	400.00	
Rogers, R. E., "	307.23	
Armstrong "	200.00	
Blake "	200.00	
Flint Library "	200.00	
Lowell, K. B., "	200.00	
Rotch Architectural Library Fund	200.00	
Lyman Fund	200.00	
Welch "	200.00	
Sawyer "	190.57	
McGregor "	100.00	
Kerr Library Fund	80.00	
From Income of Funds for Professorships and Salaries		4,324.00
As follows:—		
Nathaniel Thayer Fund. Professorship of Physics,	$1,000.00	
James Hayward Fund. Professorship of Engineering	752.00	
William P. Mason Fund. Professorship of Geology	752.00	
Henry B. Rogers Fund. General Salaries	1,000.00	
George A. Gardner Fund. General Salaries	800.00	
Sarah H. Forbes Fund. Salaries	20.00	
From W. B. Rogers Memorial Fund		12,941.00
Viz.:—Income	$13,487.00	
Less charges to reduce premiums	546.00	
From M. I. T. Alumni Subscriptions, 1908		35,701.41
Total income available for Current Expenses		$494,630.98

EXPENSE.

For General Purposes.

Salaries		$400,083.42
Department Supplies and Repairs (details on page 10)	$56,990.76	
Less: Receipts for Breakage and Supplies	12,064.68	44,026.08
Fuel, Water, Gas, and Electricity		23,577.60
Viz.:—Fuel	$17,603.87	
Water	3,284.86	
Gas	2,368.58	
Electricity	320.29	
Repairs, general (details on page 11)		16,626.62
Expense, general (details on page 11)		14,920.31
Printing and Advertising		9,078.24
Viz.:—Printing catalogues and reports	$5,405.32	
Printing lecture notes	1,304.54	
Printing and advertising, miscellaneous	4,622.64	
	$11,332.50	
Receipts from lecture notes	2,254.26	
Fire Insurance		4,526.64
Physico-Chemical Research		3,676.35
Society of Arts expenses		1,247.63
Total Current Expenses		$517,762.89

RECAPITULATION.

Total Expenses for General Purposes, as above,	$517,762.89
Total Income available for General Purposes.	494,630.98
Excess of Expense	$23,131.91

Note.

Included in "Repairs" and "Department accounts" are various expenditures for extensions, improvements, and new equipment which have not been added to assets, but have been charged to expense. Similar charges have been made in previous years which have been considered as offsets or allowances for depreciation upon general equipment.

Two of these items are as follows:—

Turbine. Mechanical Engineering Laboratories	$7,000.00
New Boilers, Condenser, Pump, Installing, etc.	$9,940.00

INCOME AND EXPENSE. SPECIAL PURPOSES.

Income.

	From Gen'l Investments.	*From special sources.*	*Total.*
Austin Fund, for awards	$5,162.50	$390.00	$5,552.50
Cheney Fund, for Reading Room	562.35		562.35
Dalton Fund, for fellowships	219.98		219.98
Letter Box Fund, for scholarships		29.75	29.75
Naval Architecture (Weld)		1,000.00	1,000.00
Perkins Fund, for fellowships	299.36		299.36
Physico-Chemical Fund		4,529.61	4,529.61
Rotch Prize Fund	200.00		200.00
Rotch "Special" Prize Fund	200.00		200.00
Saltonstall Fund, for fellowships	400.00		400.00
Sanitary Research Fund		5,655.00	5,655.00
Savage Fund, for fellowships	571.83		571.83
Swett Fund, for fellowships		412 50	412.50
Teachers' Fund, for awards	4,000.00		4,000.00
	$11,616.02	$12,016.86	$23,632.88

Expenses for Special Purposes.

	Payments for Special Purposes.	*Added to Capital of Funds.*	*Subtracted from Capital of Funds.*
Austin Fund, awards	$4,384.00	$1,168.50	
Cheney Fund, Reading Room	394.40	167.95	
Dalton Fund, fellowships	300.00		$80.02
Letter Box Fund, scholarship	50.00		20.25
Naval Architecture	1,101.27		101.27
Perkins Fund, fellowships	1,200.00		900.64
Physico-Chemical Fund	3,698.39	831.22	
Rotch Prize Fund	200.00		
Rotch "Special" Prize Fund	200.00		
Saltonstall Fund, fellowships	800.00		400.00
Sanitary Research Fund	6,290.83		635.83
Savage Fund, fellowships	250.00	321.83	
Swett Fund, fellowships	400.00	12.50	
Teachers' Fund, awards	1,500.00	2,500.00	
Totals	$20,768.89	$5,002.00	$2,138.01

Total payments	$20,768.89
Subtract, payments from capital	2,138.01
Payments from income	18,630.88
Add, income increasing funds	5,002.00
Total income, as above	$23,632.88

INCOME OF FUNDS FOR GENERAL PURPOSES ADDED TO CAPITAL OF THOSE FUNDS.

Clapp Fund	$211.99
Danforth Fund	25.62
Dickinson "	32.37
Flint "	13.37
Hunt "	5.08
Huntington "	10.97
Loring "	17.34
Mirrlees "	15.98
Nichols "	16.97
Perkins "	37.36
Russell "	90.00
Saltonstall "	426.71
Upham "	2.41
Vose "	37.87
Total	$944.04

SPECIAL INCOME ADDED TO FUNDS.

Joy Fund	$436.70	
Walker Memorial Fund	4,355.00	
	$5,735.74	
Total from funds for special purposes (p. 8)	5,002.00	
Total added to capital of funds		$10,737.74

DECREASE OF FUNDS. PAYMENTS IN EXCESS OF INCOME.

Rogers Scholarship	$158.08	
Total from funds for special purposes (p. 8)	2,138.01	
Decrease M. I. T. Alumni Fund*	6,188.59	
Total subtracted from capital of funds		8,484.68
Net increases of funds from income (p. 19)		$2,253.06

* Expenditure from balance of $10,000 brought forward from previous year.

DETAILS OF ITEMS IN INCOME STATEMENT, 1908, COMPARED WITH THE SAME ITEMS IN 1907.

Rents.

	1908.	1907.
Huntington Hall, for Lowell Lectures	$3,500.00	$3,500.00
Land and Building, Clarendon St., on account	4,500.00	8,500.00
Edge Hill Road Estate	563.61	
Cambridge Real Estate	495.86	
Use of Rooms and Gymnasium	346.25	136.00
Total Credits	$9,405.72	$12,136.00
DEDUCTIONS FROM RENT.		
Lunch Room, net loss	219.80	231.78
Rental of Armory	200.00	
Cambridge Real Estate Expenses		71.79
Edge Hill Road Estate Expenses		750.41
Total Debits	$419.80	$1,053.98
Net Credit, Rents	$8,985.92	$11,082.02

Gifts.

Charles W. Hubbard, for Applied Chemistry	$1,000.00	
Arthur Cary	500.00	$500.00
Guy Lowell	500.00	
Mrs. Wm. B. Rogers, for periodicals, etc.	225.00	225.00
Estate Caroline A. R. Whitney	200.00	750.00
A. D. Little		300.00
Mrs. Pickering, books for History Department		100.00
Mrs. Rogers, Geological Department		500.00
Saturday Club of Boston		1,000.00
	$2,425.00	$3,375.00

DETAILS OF ITEMS IN EXPENSE STATEMENT.

Salaries.

Instruction	$313,077.47	$300,847.32
Administration	39,609.32	38,218.62
Labor	47,396.63	44,415.34
	$400,083.42	$383,481.28

Department Supplies and Repairs.

Applied Mechanics	$1,980.80	$1,390.87
Architecture	1,633.90	1,598.15
Biology	1,177.21	1,229.75
Chemistry	15,201.97	14,501.78
Civil Engineering	2,008.40	1,984.42
Drawing	401.70	913.39
Economics	410.73	419.31
Electrical Engineering (Extra equipment in 1907)	3,714.66	7,142.66
English	200.83	199.96
General Library	2,295.14	2,302.10
Geology	1,271.23	1,308.73
Heat Measurement	8.00	232.18
History	649.95	749.88
Mathematics	626.55	583.39
Mechanic Arts	3,061.53	3,447.64
Mechanical Engineering (New Turbine $7,000 in 1908)	10,147.79	4,717.06
Military	477.99	612.63
Mining	3,431.31	3,634.82
Modern Languages	267.89	447.78
Naval Architecture	833.10	830.84
Physical Culture	1,870.26	1,007.34
Physics	5,319.82	5,361.76
	$56,990.76	$54,616.44

General Repairs.

	1908.	1907.
Boiler and Power House:		
Viz.:—Appropriations for Boilers and Fittings	$7,650.00	
Condenser and Pumps	2,290.00	
	$9,940.00	
Sundries	134.35	811.55
Total	$10,074.35	$811.55
Rogers Building	1,243.11	1,815.41
Walker Building	980.74	705.25
Lowell Building	736.05	1,002.82
Engineering Buildings A and B	572.44	554.67
Mechanical Laboratories	464.28	255.17
Gymnasium Building	224.64	69.06
Pierce Building	180.38	346.55
Engineering Building C	100.40	129.23
Miscellaneous	2,050.23	126.84
	$16,626.62	$5,816.55

General Expense.

	1908.	1907.		
Stationery and Office Supplies			$2,398.17	$2,609.76
Sundries			2,292.89	3,067.57
Postage			1,922.20	1,676.42
Telephone Service, Installing Stations, Rentals, Repairs, etc.			1,809.19	1,428.90
Diplomas and Commissions			1,341.90	567.22
Janitor's Supplies			960.06	1,187.41
Washing			889.75	808.86
Engine Room Supplies:				
Oil	$425.02	$480.95		
Waste	90.70	203.51		
Sundries	92.83	105.14	608.55	789.60
Examinations			586.00	470.00
Taxes, Brookline, etc.			458.85	471.27
Removing Ashes			378.55	356.40
Ice			324.00	400.60
Express			251.48	227.11
Graduation Exercises			237.62	276.55
Furniture			195.60	719.07
Window Shades			167.62	68.20
Legal Services			50.00	
Glass			40.53	40.09
Medical Services			7.35	
Architectural Annual				1,000.00
Alumni Association				1,000.00
N. E. Trust Co. Deposit Vault				75.00
State St. Trust Co. Deposit Vault				75.00
			$14,920.31	$17,315.03

Fuel, Water, Gas and Electricity.

Fuel	$17,603.87	$16,832.38
Water	3,284.86	3,010.30
Gas	2,368.58	2,382.08
Electricity (net)	320.29	243.53
	$23,577.60	$22,468.29

MASSACHUSETTS INSTITUTE
BALANCE SHEET,

ASSETS.

INVESTMENTS, GENERAL.

Bonds.

$26,000.00	Am. Dock & Improvement Co. 5s	due	1921	$26,960.00	
105,000.00	American Tel. & Tel. Co. 4s	"	1929	104,700.00	
33,000.00	American Tel. & Tel. Notes 5s	"	1910	31,968.75	
25,000.00	Atchison, Top. & St. Fé R.R. 4s	"	1995	25,000.00	
34,000.00	Baltimore & Ohio R.R. 3½s	"	1925	30,090.00	
14,000.00	Bur. & Mo. River (Neb.) R.R. 6s non-exempt	"	1918	4,000,00	
2,000.00	Bur. & Mo. River (Neb.) R.R. 6s exempt	"	1918	2,000.00	
43,000.00	Chesapeake & Ohio R.R. 5s	"	1939	48,780.00	
4,000.00	Chicago, Burl. & Quincy R.R. 4s	"	1922	3,100.00	
6,000.00	Chi. Junc. & Union S. Yds. 5s	"	1915	6,232.00	
50,000.00	Chi. Junc. & Union S. Yds. 4s	"	1940	49,250.00	
30,000.00	Chi., Mil. & St. Paul R.R. 7s	"	1910	31,137.00	
100,000.00	Chi. & W. Michigan R.R. 5s	"	1921	101,200.00	
3,000.00	Hannibal & St. Joseph R.R. 6s	"	1911	3,000.00	
3,000.00	Illinois Central R.R. 4s	"	1951	3,000.00	
120,000.00	Illinois Steel Co. non-conv. 5s	"	1913	119,586.25	
50,000.00	Interboro Rapid Transit 5s	"	1910	48,625.00	
7,000.00	K. C., Clinton & Spgfld. R.R. 5s	"	1925	6,289.21	
50,000.00	K. C., Ft. Scott & Memphis R.R. 6s,	"	1928	56,783.00	
8,500.00	K. C., Mem. & Birmingham R.R. 4s,	"	1934	8,287.50	
50,000.00	Kansas City Stock Yards 5s	"	1910	50,760.00	
3,000.00	Lake Shore & Mich. Southern 4s	"	1928	3,000.00	
75,000.00	Lake Shore & Mich. Southern deb. 4s	"	1931	75,000.00	
100,000.00	Long Island R.R. 4s	"	1949	96,137.50	
20,000.00	Louisville & Nashville 4s	"	1923	19,750.00	
25,000.00	Mass. Elec. Co. notes 4½s	"	1910	24,500.00	
50,000.00	N. E. Tel. & Tel. Co. 4s	"	1930	50,441.00	
52,000.00	N. Y. C. & H. R. R.R. (L. S.) 3½s	"	1998	46,046.65	
36,000.00	N. Y. G. Equipment 5s	"	1919	34,740.00	
31,000.00	N. Y., N. H. & H. 6s	"	1948	35,602.00	
50,000.00	Northern Pac. Gt. Northern Joint 4s,	"	1921	48,500.00	
50,000.00	Oregon R.R. & Navigation Co. 4s	"	1946	51,110.00	
50,000.00	Oregon Short Line 4s	"	1929	48,500.00	
5,000.00	Ozark Equipment Co. 5s	"	1910	5,000.00	
50,000.00	Rio Grande & Western R.R. 4s	"	1939	49,180.00	
25,000.00	Southern Ry., St. Louis Div. 4s	"	1951	24,875.00	
5,000.00	Terminal Asso. St. Louis 4s	"	1953	5,000.00	
50,000.00	Union Pacific R.R. 4s	"	1947	51,596.00	
25,000.00	Wabash Equipment 4½s	"	1912	24,360.00	
19,000.00	Wabash Equipment 4½s	"	1916	18,259.00	
100,000.00	West End St. Ry. 4s	"	1917	101,680.00	$1,574,025.86

Stocks.

Shares.					
172	Boston & Albany R.R.	par	100	34,456.50	
1	Boston Ground Rent Trust	"	1000	900.00	
64	Boston Real Estate Trust	"	1000	68,605.64	
80	Chi., Mil. & St. Paul R.R. Pf.	"	100	5,738.00	
12	Cocheco Mfg. Co.	"	500	6,000.00	
2	Dwight Mfg. Co.	"	500	1,600.00	
27	Essex Company	"	50	3,780.00	
31	Great Falls Mfg. Co.	"	100	3,472.00	
56	Hamilton Woolen Co.	"	100	5,390.00	
17	Pepperell Mfg. Co.	"	100	2,789.50	132,731.64
	Amount carried up.				1,706,757.50

OF TECHNOLOGY.

SEPTEMBER 30, 1908.

LIABILITIES.

FUNDS FOR GENERAL PURPOSES.

Armstrong, George Robert	[illegible]	
Bartlett, Sidney	[illegible]	
Blake, Stanton	[illegible]	
Choate, Charles	[illegible]	
Dorr, George B.	[illegible]	
Edwards, Martha Ann	[illegible]	
James Fund	[illegible]	
Lowell, Katharine B.	[illegible]	
Lyman, Arthur T.	[illegible]	
McGregor Fund	[illegible]	
Nash, Nathaniel C.	[illegible]	
Perkins, Richard	[illegible]	
Randall, John W. and Belinda I.	[illegible]	
Rogers, Robert E.	[illegible]	
Rogers, William Barton	[illegible]	
Sawyer, Samuel E.	[illegible]	
Thayer, Nathaniel	[illegible]	
Welch, Albion K. P.	[illegible]	
Weld, Charles G.	[illegible]	
Wheeler, Alexander S.	[illegible]	[illegible]

FUNDS FOR SALARIES.

Forbes, Sarah H., for General Salaries	[illegible]	
Gardner, George A. " " "	[illegible]	
Haywood, James, Professorship of Engineering	[illegible]	
Mason, William P., " " Geology	[illegible]	
Rogers, Henry B., General Salaries	[illegible]	
Thayer, Nathaniel, Professorship of Physics	[illegible]	[illegible]

FUNDS FOR SCHOLARSHIPS.

Atkins, Elisha	[illegible]	
Billings, Student	[illegible]	
Clapp, Lucius	[illegible]	
Dalton, Graduate Chemical	[illegible]	
Danforth, Isaac W.	[illegible]	
Dickinson	[illegible]	
Farnsworth	[illegible]	
Flint, Charles Lewis	[illegible]	
Hunt, T. Sperry	[illegible]	
Huntington, William F.	[illegible]	
Joy	[illegible]	
Loring, Elisha Thatcher	[illegible]	
Mirlees, James H.	[illegible]	
Nichols	[illegible]	
Nichols, Charles C.	[illegible]	
Perkins, Richard	[illegible]	
Perkins, Willard B.	[illegible]	
Rogers, William Barton	[illegible]	
Russell, Richard Lee	[illegible]	
Saltonstall, Henry	[illegible]	
Savage, James	[illegible]	
Sherwin, Thomas	[illegible]	
Swett, Susan H.	[illegible]	
Upham, Susan	[illegible]	
Vose, Ann White	[illegible]	[illegible]
Amount carried up		[illegible]

ASSETS.

				BALANCE
Amount brought up				1,706,757.50
INVESTMENTS W. B. ROGERS MEMORIAL FUND.				
BONDS.				
$25,000.00	Atchison, Top. & St. Fé R.R. 4s	due 1995	$24,470.00	
6,000.00	Baltimore & Ohio R.R. 3½s	" 1925	5,310.00	
7,000.00	Chesapeake & Ohio R.R. 5s	" 1939	7,940.00	
40,000.00	Chi. Junc. & Union S. Yds. 5s	" 1915	41,550.00	
4,000.00	Cin., Ind., St. Louis & Chicago R.R. 6s	" 1920	4,000.00	
37,500.00	Detroit, G.Rapids & Western R.R. 4s,	" 1946	37,500.00	
35,000.00	Fort St. Union Depot 4½s	" 1941	34,825.00	
27,000.00	Kansas City Belt R.R. 6s	" 1916	27,875.00	
4,000.00	K. C., Ft. Scott & Gulf R.R. 5s	" 1911	4,000.00	
1,000.00	Lincoln & Northwestern R.R. 7s	" 1910	1,000.00	
31,000.00	N. Y. C. & H. R. R.R. deb. 4s	" 1934	30,225.00	
1,000.00	N. Y. Central Equipment 5s	" 1919	965.00	
3,200.00	Republican Valley R.R. 6s	" 1919	3,200.00	
24,000.00	Rome, Watertown & Ogdensburg R.R. 5s	" 1922	25,690.00	
1,000.00	Wabash Equipment 4½s	" 1916	961.00	249,511.00
INVESTMENTS WALKER MEMORIAL FUND.				
$30,000.00	Am. Tel. & Tel. Co. 4s	due 1929	30,300.00	
1,000.00	Chi., Bur. & Quincy R.R. 5s	" 1913	1,055.00	
54,000.00	N. Y. C. & H. R. R.R. 3½s	" 1998	47,986.35	
14,000.00	Oregon Short Line 5s	" 1946	16,310.00	
5,000.00	St. Louis Iron Mt. 4s	" 1933	4,812.50	
7,000.00	Wabash Equipment 4½s	" 1916	6,764.45	107,228.30
INVESTMENTS JOY SCHOLARSHIP FUND.				
Mass. Hospital Life Insurance Co.			5,000.00	
Deposits in Savings Banks			6,164.22	11,164.22
INVESTMENTS SWETT SCHOLARSHIP FUND.				
Mass. Hospital Life Insurance Co.				10,000.00
INVESTMENTS RUSSELL FELLOWSHIP FUND.				
$2,000.00	Conveyancers Title Ins. Co. Mort. 4s	1908		2,000.00
INVESTMENTS, REAL ESTATE.				
Clarendon St. Land and Building (Grundmann Studios)			$142,762.94	
Massachusetts Avenue, Cambridge			16,154.38	158,917.32
CURRENT ASSETS.				
Notes Receivable			12,800.00	
Students' Notes Receivable			570.50	
Loan to Copley Society			5,000.00	
Physico-Chemical Research Fund (Debit balance)			225.42	
Cash Balance September 30, 1908			82,854.95	101,450.87
Tota Investments and Current Assets (carried up)				$2,347,029.21

SHEET—*Continued.*

LIABILITIES.

Amount brought up		1,202,789.19
Funds for Libraries and Reading Room.		
Flint, Charles Lewis	5,000.00	
Kerr, William Hall	2,000.00	
Rotch Architectural Library	5,000.00	
Cheney, Ednah Dow, for Margaret Cheney Reading Room,	14,226.79	26,226.79
Funds for Prizes.		
Rotch Prize Fund	5,200.00	
Rotch "Special" Prize Fund	5,200.00	10,400.00
Legacies.		
Gaffield, Thomas, 1906	3,343.18	
Haynes, John C., 1908	5,000.00	
Merriam, Charles, 1907	25,000.00	
Pope, Macy S., 1906	25,028.81	
Upton, George B., 1905	5,000.00	63,371.99
Other Funds.		
Austin, Edward		380,770.22
Bursar's Fund		6,000.00
Dorr, Susan E. (annuity to Samuel Dorr)		19,288.48
Electrical Engineering Laboratory, Augustus Lowell		68,000.00
Richardson, Charlotte Billings, Industrial Chemistry		37,378.78
Rotch Architectural		25,000.00
Saltonstall		43,097.71
Teachers'		113,020.00
Walker Memorial		116,388.40
Miscellaneous Funds and Accounts.		
Cabot Medal Fund		100.92
Dormitory Fund		1,868.96
Letter Box Deposits (Scholarship)		61.25
M. I. T. Alumni Fund, Reserve		3,811.41
Naval Architecture Fund (Weld)		87.81
Roentgen-Ray Experiment Fund		956.50
Sanitary Research Laboratory Fund		705.22
Deposits for Breakages and Supplies, due		1,467.35
Deposits for Breakages and Supplies, in advance		6,875.00
Tuition Fees, in advance		77,015.00
State of Massachusetts, in advance		4,000.00
Accounts Payable		18,174.10
Total Funds and Liabilities (carried up)		$2,226,855.08

ASSETS.		BALANCE
Total Investments and Current Assets (brought up) .		2,347,029.21
EDUCATIONAL PLANT. *		
Land and Buildings, Book Values.		
Rogers Building	$200,000.00	
Walker Building	150,000.00	
Engineering Building A, Trinity Place	90,000.00	
Engineering Building B " "	57,857.10	
Engineering Building C " "	47,561.08	
Henry L. Pierce Building " "	154,297.05	
Boiler and Power House " "	26,916.74	
Lot No. 1 " "	76,315.69	
Lot No. 2 " "	137,241.60	
Lot No. 3 " "	282,286.35	
Electrical Eng. Building, Augustus Lowell, Clarendon St.	121,790.93	
Mechanic Arts Building, Garrison St.	30,000.00	
Land, Garrison St.	50,840.00	
Gymnasium Building, Exeter St.	12,624.07	
Athletic Field, Brookline	112,964.32	
Technology Union, Trinity Court	8,834.42	
	$1,559,529.35	
Equipment, Book Values.		
In Engineering Building	16,555.24	
In Electrical Engineering Building	87,282.24	
In Mechanical Laboratories	20,628.56	
Total Educational Plant, Book Values		1,683,995.39
Grand Total		$4,031,024.60

* The values of land, buildings and equipment under this head are nominal values which have been carried on the books at these figures for many years. A complete appraisal of all these properties will soon be made, and amounts closely in accord with the actual costs, or with the appraised values, will then be entered in the books.

SHEET—*Continued.*

LIABILITIES.

Total Funds and Liabilities (brought up)		2,226,855.08
Balancing Account,*		1,804,169.52
Viz.:—Balance September 30, 1907	$1,816,023.15	
Cr. Gain from sale Utah & Northern	125.00	
From Alumni Fund of prior year†	6,188.59	
From gifts for new Technology Union Building	5,850.00	
	$1,828,186.74	
Dr. Excess of expense over income	23,131.91	
Physico-Chemical Fund, loss of prior years charged this year	885.31	24,017.22
Balance September 30, 1908, as above		$1,804,169.52
Grand Total		$4,031,024.60

* Heretofore entitled "M. I. T. Stock Account." This balance represents (1st) the excess of total investments and current assets, as recorded in the books, over the total of funds and liabilities, and (2d) the total book values of "educational plant," viz:—

Total securities and current assets	$2,347,029.21
Total funds and liabilities	2,226,855.08
Excess of assets	$120,174.13
Book values of "educational plant"	1,683,995.39
Total	$1,804,169.52

† Used for Technology Union Building.

INCREASES AND DECREASES OF FUNDS.

Funds for General Purposes.	*Funds Sept. 30, 1907.*	*Income and other increases of funds.*	*Expenditure and other decreases of funds.*	*Funds Sept. 30, 1908.*
Armstrong, George Robert . .	5,000.00	200.00	200.00	5,000.00
Bartlett, Sidney	10,000.00	400.00	400.00	10,000.00
Blake, Stanton	5,000.00	200.00	200.00	5,000.00
Choate, Charles	25,000.00	1,000.00	1,000.00	25,000.00
Dorr, George B.	49,573.47	1,982.94	1,982.94	49,573.47
Edwards, Martha Ann	30,000.00	1,200.00	1,200.00	30,000.00
James Fund	163,654.21	6,546.17	6,546.17	163,654.21
Lowell, Katharine B.	5,000.00	200.00	200.00	5,000.00
Lyman, Arthur T.	5,000.00	200.00	200.00	5,000.00
McGregor Fund	2,500.00	100.00	100.00	2,500.00
Nash, Nathaniel C.	10,000.00	400.00	400.00	10,000.00
Perkins, Richard	50,000.00	2,000.00	2,000.00	50,000.00
Randall, John W. and Belinda L.	83,452.36	3,338.09	3,338.09	83,452.36
Rogers, Robert E.	7,680.77	307.23	307.23	7,680.77
Rogers, William Barton . . .	250,225.00	13,487.00	13,487.00	250,225.00
Sawyer, Samuel E.	4,764.40	190.57	190.57	4,764.40
Thayer, Nathaniel	25,000.00	1,000.00	1,000.00	25,000.00
Welch, Albion K. P.	5,000.00	200.00	200.00	5,000.00
Weld, Charles G.	0.00	15,000.00	0.00	15,000.00
Wheeler, Alexander S.	5,000.00	0.00	0.00	5,000.00
	741,850.21	47,952.00	32,952.00	756,850.21
Funds for Salaries.				
Forbes, Sarah H. For Salaries,	500.00	20.00	20.00	500.00
Gardner, George A. For Salaries	20,000.00	800.00	800.00	20,000.00
Haywood, James. For Professor of Engineering	18,800.00	752.00	752.00	18,800.00
Mason, Wm. P. For Professor of Geology	18,800.00	752.00	752.00	18,800.00
Rogers, Henry B. For Salaries,	25,000.00	1,000.00	1,000.00	25,000.00
Thayer, Nathaniel. For Professor of Physics	25,000.00	1,000.00	1,000.00	25,000.00
	108,100.00	4,324.00	4,324.00	108,100.00
Funds for Scholarships.				
Atkins, Elisha	5,000.00	200.00	200.00	5,000.00
Billings, Student	50,000.00	2,000.00	2,000.00	50,000.00
Clapp, Lucius	5,299.84	211.99	0.00	5,511.83
Dalton, Graduate Chemical . .	5,499.39	219.98	300.00	5,419.37
Danforth, Isaac W.	5,640.64	225.62	200.00	5,666.26
Dickinson	40,809.27	1,632.37	1,600.00	40,841.64
Farnsworth	5,000.00	200.00	200.00	5,000.00
Flint, Charles Lewis	5,334.14	213.37	200.00	5,347.51
Hunt, T. Sperry	3,251.92	130.08	125.00	3,257.00
Huntington, William F. . . .	5,274.13	210.97	200.00	5,285.10
Joy	11,133.77	436.70	0.00	11,570.47
Loring, Elisha Thatcher . . .	5,433.45	217.34	200.00	5,450.79
Mirlees, James H.	2,899.42	115.98	100.00	2,915.40
Nichols	5,000.00	200.00	200.00	5,000.00
Nichols, Charles C.	5,424.32	216.97	200.00	5,441.29
Perkins, Richard	53,434.07	2,137.36	2,100.00	53,471.43
Perkins, Willard B.	7,483.89	299.36	1,200.00	6,583.25
Rogers, William Barton . . .	11,735.40	766.92	925.00	11,577.32
Russell, Richard Lee	2,249.97	90.00	0.00	2,339.97
Saltonstall, Henry	10,000.00	400.00	800.00	9,600.00
Savage, James	14,295.78	571.83	250.00	14,617.61
Sherwin, Thomas	5,050.00	200.00	200.00	5,050.00
Swett, Susan H.	10,582.95	412.50	400.00	10,595.45
Upham, Susan	1,310.27	52.41	50.00	1,312.68
Vose, Ann White	60,946.74	2,437.87	2,400.00	60,984.61
	338,089.36	13,799.62	14,050.00	337,838.98

	Funds Sept. 30, 1907.	*Income and other increases of funds.*	*Expenditure and other decreases of funds.*	*Funds Sept. 30, 1908.*
FUNDS FOR LIBRARIES AND READING ROOM.				
Flint, Charles Lewis	5,000.00	200.00	200.00	5,000.00
Kerr, Wm. Hall	2,000.00	80.00	80.00	2,000.00
Rotch Architectural Library	5,000.00	200.00	200.00	5,000.00
Cheney, E. D., for Margaret Cheney Reading Room	14,058.84	562.35	394.40	14,226.79
	26,058.84	1,042.35	874.40	26,226.79
FUNDS FOR PRIZES.				
Rotch Prize Fund	5,200.00	200.00	200.00	5,200.00
Rotch "Special" Prize Fund	5,200.00	200.00	200.00	5,200.00
	10,400.00	400.00	400.00	10,400.00
LEGACIES.				
Gaffield, Thomas, 1906	2,043.18	1,300.00	0.00	3,343.18
Haynes, John C., 1908	0.00	5,000.00	0.00	5,000.00
Merriam, Charles, 1907	25,000.00	0.00	0.00	25,000.00
Pope, Macy S., 1906	25,028.81	0.00	0.00	25,028.81
Upton, George B., 1905	5,000.00	0.00	0.00	5,000.00
	57,071.99	6,300.00	0.00	63,371.99
OTHER FUNDS.				
Austin, Edward	379,601.72	16,230.00	15,061.50	380,770.22
Bursar's Fund	0.00	6,000.00	0.00	6,000.00
Dorr, Susan E.	19,288.48	771.54	771.54	19,288.48
Electrical Engineering Laboratory, Augustus Lowell	68,000.00	0.00	0.00	68,000.00
Richardson, Charlotte Billings, Industrial Chemistry	37,378.78	1,495.15	1,495.15	37,378.78
Rotch Architectural	25,000.00	1,000.00	1,000.00	25,000.00
Saltonstall	42,671.00	1,706.84	1,280.13	43,097.71
Teachers'	110,520.00	4,000.00	1,500.00	113,020.00
Walker Memorial	112,033.40	4,355.00	0.00	116,388.40
	794,493.38	35,558.53	21,108.32	808,943.59
MISCELLANEOUS FUNDS.				
Cabot Medal Fund	100.92	0.00	0.00	100.92
Dormitory Fund	1,868.96	0.00	0.00	1,868.96
Letter Box Fund, scholarship	81.50	29.75	50.00	61.25
M. I. T. Alumni Fund, Reserve	10,000.00	35,701.41	41,890.00	3,811.41
Naval Architecture Fund (Weld)	189.08	1,000.00	1,101.27	87.81
Physico-Chemical Fund	*1,056.64	8,205.96	7,374.74	*225.42
Roentgen-Ray Exp't Fund	956.50	0.00	0.00	956.50
Sanitary Research Fund	1,341.05	5,655.00	6,290.83	705.22
	13,481.37	50,592.12	56,706.84	7,366.65
Grand Totals	2,089,545.15	159,968.62	130,415.56	2,119,098.21

Total increases of funds		$159,968.62
Total decreases of funds		130,415.56
		29,553.06
Increases from capital sources		27,300.00
Increases from income (net)		$2,253.06

*Debit balance.

DETAILS OF ITEMS OF CAPITAL RECEIPTS AND PAYMENTS.

Capital Receipts.

GIFTS AND BEQUESTS. GENERAL PURPOSES.

Charles G. Weld Fund (new)	$15,000.00
John C. Haynes Legacy (new)	5,000.00
Thomas Gaffield Legacy (additional)	1,300.00
	$21,300.00

GIFTS AND BEQUESTS. SPECIAL PURPOSES.

Bursar's Fund. Lyman F. Rhoads	$6,000.00
For New Technology Union Building	5,850.00
Total Gifts and Bequests on capital account	33,150.00

SECURITIES SOLD OR MATURED. GENERAL PURPOSES.

$1,000.00	Burl. & Mo. River (Neb.) R.R. 6%	1918	$1,000.00
1,000.00	New Eng. Tel. & Tel. Co. 6%	1908	1,000.00
50,000.00	Utah & Northern R.R. 1st 7%	1908	50,125.00
2,000.00	Ozark Equipment Co. 5%	1910	2,000.00
			$54,125.00

SECURITIES MATURED. ROGERS MEMORIAL FUND.

1,000.00	Atchison & Nebraska R.R. 7%	1908	$1,000.00
	Total securities sold or matured		$55,125.00

Capital Payments.

SECURITIES BOUGHT. GENERAL PURPOSES.

31,000.00	N. Y., N. H. & H. R.R. 6%	1948	$35,727.50
36,000.00	N. Y. Central Equipment Co. 5%	1919	34,740.00
			$70,467.50

SECURITIES BOUGHT. ROGERS MEMORIAL FUND.

1,000.00	N. Y. Central Equipment Co. 5%	1919	$965.00
	Total securities bought		$71,432.50

BOSTON, Dec. 4, 1908.

Mr. Edward L. Parker, a public accountant, employed by this committee, has examined the accounts of the Treasurer of the MASSACHUSETTS INSTITUTE OF TECHNOLOGY for the year ended September 30, 1908, and has verified the Students' Notes and the cash at office and in banks, and his report is hereto annexed.

We have verified the list of securities held by the Institute.

CHARLES C. JACKSON,
JAMES P. TOLMAN, } *Auditing Committee.*

BOSTON, Dec. 4, 1908.

To the Auditing Committee of the
Massachusetts Institute of Technology:

GENTLEMEN,—I have audited the accounts of the treasurer, Mr. Francis R. Hart, for the year ending September 30, 1908.

The accounts are correct, the payments are duly vouched, and the receipts from students' fees and all other income are duly accounted for. The cash at office and in banks, according to the statements from the banks of deposit, is correct. The Students' Notes are on hand. The statement of Assets and Liabilities as shown by the Treasurer's report of September 30, 1908, is in accordance with the books.

Respectfully submitted,

EDWARD L. PARKER,
Public Accountant.

COMPARISONS OF INCOME AND EXPENSE FOR TWELVE YEARS

INCOME.

Year ending September 30	1897	1898	1899	1900	1901	1902	1903	1904	1905	1906	1907	1908
Students' fees	$215,045.00	$216,832.00	$207,118.00	200,744.93	221,583.00	252,987.75	286,660.55	297,344.25	320,585.55	313,816.25	313,107.00	318,394.10
Gift, State of Massachusetts	25,000.00	25,000.00	25,000.00	25,000.00	25,000.00	25,000.00	25,000.00	25,000.00	25,000.00	25,000.00	25,000.00	25,000.00
Rents (net)	15,274.23	11,318.99	16,115.81	12,575.10	8,729.93	5,982.80	10,065.03	10,348.81	10,606.50	10,757.68	11,082.02	8,985.92
Laboratory supplies and breakages,	9,902.17	8,863.02	9,546.57	10,829.84	10,844.99	11,794.01	16,080.40	11,925.99	12,877.43	11,936.36	12,638.78	12,964.68
Interest	5,020.58	9,673.03	12,890.74	22,882.78	8,578.37	8,920.91	5,153.38	3,410.38	2,599.59	4,176.04	4,659.68	3,295.59
U. S. Act of 1890			8,333.34	8,333.34	8,333.34	8,333.34	8,333.34	8,333.34	8,333.34	8,333.34	10,000.00	11,666.67
U. S. Act of 1862			5,717.56	2,188.59	5,468.34	5,501.68	5,223.94	6,293.06	4,191.96	5,306.68	5,306.68	5,306.68
State Endowment Fund	7,666.67	8,000.00										
State Agricultural Fund	5,896.00											
State Mechanics Art Fund		5,131.37										
State Scholarships	4,000.00	4,000.00	4,000.00	4,000.00	4,000.00	4,000.00	4,000.00	4,000.00	4,000.00	4,000.00	4,000.00	4,000.00
Gifts	1,125.00	700.00	2,861.34	600.00	4,814.62	1,225.00	895.75	2,394.15	3,251.81	1,825.00	3,375.00	2,425.00
Totals	288,929.65	289,518.41	291,583,36	287,154.58	297,352.59	323,745.49	361,412.39	369,049.98	391,446.18	385,151.35	389,169.16	392,038.64
Income of funds:												
For general purposes	9,196.43	12,494.60	23,643.98	14,876.18	24,889.57	27,976.52	26,710.42	26,235.12	25,975.19	26,438.67	31,350.33	40,323.11
" scholarships, fellowships, awards, etc.	9,082.04	9,770.15	11,455.15	24,179.51	24,507.83	29,955.15	24,444.87	26,795.15	33,205.27	29,663.58	28,712.65	28,415.90
" salaries	3,942.00	3,504.00	4,304.00	4,304.00	4,314.00	4,324.00	4,324.00	4,324.00	4,324.00	4,324.00	4,324.00	4,324.00
" libraries	540.00	480.00	480.00	480.00	480.00	480.00	480.00	480.00	480.00	480.00	480.00	480.00
Of Rogers Memorial Fund	9,814.00	10,949.00	10,877.63	10,900.48	10,853.00	10,838.00	10,970.50	10,610.11	10,815.00	10,845.75	10,850.50	12,941.00
" Rotch Architectural Fund			1,000.00	1,000.00	1,000.00	1,000.00	1,000.00	1,000.00	1,000.00	1,000.00	1,000.00	1,000.00
" Rotch Prize funds	450.00	450.00	400.00	400.00	400.00	400.00	400.00	400.00	400.00	400.00	400.00	400.00
" Other funds	781.50	125.00	218.50	125.00	81.37	50.00	75.00	50.00	75.00			
Totals from funds	33,805.97	37,772.75	52,379.26	56,265.17	66,525.77	75,023.67	68,404.79	69,894.38	76,274.46	73,152.00	77,117.48	87,884.01
Miscellaneous income:												
Sale of lecture notes	2,753.28	2,593.87	2,463.60	2,562.72	2,805.30	3,218.10	4,093.27	4,461.15	4,032.15	3,624.04	2,292.26	2,254.26
Boston University	1,150.00	1,150.00	1,150.00	1,150.00	1,150.00	1,150.00	2,898.00	2,650.00	94.50			
Augustus Lowell for Lowell Courses	8,700.00	8,700.00	9,000.00	9,000.00	7,714.41	5,757.15	6,105.70					
Alumni Fund Committee										42,583.61	*36,588.04	35,701.41
Total income	$335,338.90	339,735.03	356,576.22	356,132.47	375,548.07	408,894.41	442,914.15	446,055.51	471,847.29	504,511.00	505,166.94	517,878.32

* Also $10,000 reserved for capital purposes.

COMPARISONS OF INCOME AND EXPENSE FOR TWELVE YEARS.

EXPENSE.

Year ending Sept. 30	1897	1898	1899	1900	1901	1902	1903	1904	1905	1906	1907	1908
Salaries:												
Instruction	$183,337.99	$186,170.02	191,129.25	198,838.30	209,191.14	228,864.05	243,920.91	261,458.83	265,577.73	286,039.37	300,847.32	313,077.47
Administration	20,393.24	24,266.88	22,422.59	23,350.65	25,898.43	32,796.04	37,643.09	37,587.98	39,119.23	39,196.79	38,218.62	39,609.32
Labor	19,013.19	21,518.82	26,368.78	26,883.10	27,920.25	29,841.20	38,009.58	41,602.62	41,992.92	43,268.39	44,415.34	47,396.63
Paid by Gift	500.00	500.00	458.00	500.00	500.00	500.00	500.00					
Total salaries and wages	223,244.42	232,455.72	240,378.62	249,572.05	263,509.82	292,001.29	320,073.58	340,649.43	346,689.88	368,504.55	383,481.28	400,083.42
General expenses, including insurance	14,122.07	17,245.67	25,809.66	19,046.01	21,114.17	19,724.99	34,552.66	22,608.88	19,853.01	17,181.25	20,461.07	19,446.95
Repairs, general	11,232.57	27,206.89	33,678.83	12,406.00	9,381.28	13,648.76	15,986.58	11,911.07	9,973.39	16,843.91	5,816.55	16,626.62
Fuel, water, gas and electricity	11,973.50	10,113.88	13,116.81	13,316.21	17,556.00	17,648.79	32,771.50	27,086.25	23,752.59	21,248.27	22,468.29	23,577.60
Printing and advertising	6,951.33	6,384.10	7,209.11	11,049.06	12,746.05	12,477.18	14,131.93	16,799.49	18,412.66	12,295.17	10,162.72	11,332.50
Department supplies and repairs	34,885.28	34,784.05	39,337.38	41,487.55	44,755.50	39,903.27	49,978.10	66,269.94	45,039.59	58,853.69	54,616.44	56,990.76
Payments from Physico-Chemical Research fund								3,000.00	3,000.00	3,000.00	3,000.00	3,676.35
Rents	380.00	380.00	380.00	380.00	380.00	1,783.63	466.70					
Interest	12,292.05	5,476.17	1,000.00	1,000.00								
Exposition exhibits		326.62	33.41	971.93	927.84	22.55	85.00	3,272.99	313.17			
Mechanical engineering	2,657.89	500.00	4,395.31									
Other departments	5,910.23		143.50									
Miscellaneous		1,453.67				25.00						
	100,404.92	103,871.05	125,104.01	99,656.76	106,860.84	105,234.17	147,972.47	150,948.62	120,344.41	129,422.29	116,525.07	131,650.78
Payments from special funds:												
From Fellowship funds	800.00	800.00	800.00	800.00	800.00	800.00	1,650.00	900.00	2,100.00	1,400.00	1,800.00	1,350.00
" Edward Austin Fund, awards				4,169.36	3,856.55	5,385.00	2,474.72	3,387.50	5,910.15	5,312.50	3,935.00	4,384.00
" Teachers' Fund, awards				1,000.00	1,200.00	3,800.00	500.00	3,400.00	5,700.00	1,530.00	2,350.00	1,500.00
" Rotch Fund, prizes	450.00	450.00	400.00	400.00	400.00	400.00	400.00	400.00	400.00	400.00	400.00	400.00
	1,250.00	1,250.00	1,200.00	6,369.36	6,256.55	10,385.00	5,024.72	8,087.50	14,110.15	8,642.50	8,485.00	7,634.00
Society of Arts, expenses	2,164.60	593.31	777.01	127.84	796.71	1,408.94	169.82	1,775.62	1,235.20	1,389.44	1,008.15	1,247.63
Margaret Cheney Reading Room									49.97	448.43	570.00	394.40
Lowell Institute Courses	8,700.00	8,700.00	9,000.00	9,000.00	7,714.41	5,757.15	6,105.70					
Total expenses	335,763.94	346,870.08	376,459.64	364,726.01	385,138.33	414,786.55	479,346.29	501,461.17	482,429.61	508,407.21	510,069.50	541,010.23
Total income (p. 22)	335,338.90	339,735.03	356,576.22	356,132.47	375,548.07	408,894.41	442,914.15	446,055.51	471,847.29	504,511.00	505,166.94	517,878.32
Excess of expense for year	$425.04	7,135.05	19,883.42	8,593.54	9,590.26	5,892.14	36,432.14	55,405.66	10,582.32	3,896.21	4,902.56	23,131.91

Volume 45 Number 2

BULLETIN

OF THE

Massachusetts Institute of Technology

BOSTON

REPORTS

OF THE

PRESIDENT AND TREASURER

SENTED AT THE DECEMBER MEETING OF THE CORPORATION

JANUARY, 1910

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REPORT OF THE TREASURER.

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Report of the President.

) THE MEMBERS OF THE CORPORATION:

I have the honor to present to you today a report upon e work of the Institute during the preceding year and upon me of the larger problems that must be dealt with in the e future.

CHANGES IN THE CORPORATION AND WITHIN THE INSTITUTE.

The Corporation has suffered the loss of two of its life mbers through the resignation of Mr. Francis Blake and r. David R. Whitney. These gentlemen have unfortutely found it necessary to resign after long and valued vice, and after displaying their keen interest in the wele of the Institute in many practical ways. In accordance h the by-law limiting the number of life members to thirtye as soon as the number shall have been reduced below t limit, the resignation of these two members left only e vacancy. This has been most happily filled by the ction of Mr. Francis R. Hart, an alumnus of the Instie, who has already rendered signal service to his Alma ter in the difficult and important post of Treasurer. The titute has been peculiarly fortunate in a succession of e and devoted treasurers, but none could have worked re loyally and enthusiastically in its interests than Mr. rt. Unfortunately the increasing load of work and reisibility imposed by the Corporation that has the first im on his energies makes it impossible for him to continue give to the treasurership the time and thought that in

his judgment the difficulties of the position demand. He has therefore deemed it necessary to tender his resignation. To fill the vacancy thus caused the Executive Committee has been fortunate in securing the services of Mr. William B. Thurber, another distinguished alumnus of the Institute, who will bring to the task energy, enthusiasm, and the advantages of a wide business experience. His election is subject to your confirmation today.

The Corporation has welcomed to its membership three new term members, elected from the nominees of the Alumni Association—Messrs. Walter B. Snow, Theodore W. Robinson, and Charles R. Richards.

I should perhaps remind you that I was duly elected as President of the Institute towards the end of 1908, but that my obligations to Columbia University in the City of New York made it impossible to undertake the active duties of the position until the first of June, 1909. I was inaugurated with impressive ceremony on the 7th of June. The difficult period of the Institute's history since the resignation of Dr. Pritchett has been made memorable by a striking manifestation of the Technology spirit at its very best. Few men can realize what self-sacrifice is involved when a man of science of the front rank as an original investigator lays aside his chosen work and devotes all his time and thought and energy to administrative duties. You have already placed on record your appreciation of the services rendered by Dr. Noyes as Acting President; and I may add that his example cannot fail to be a lasting and impressive reminder to his successors in the presidential office of the high standards that they must endeavor to maintain. I feel that it is an unusual honor to follow such a man and an unusual privilege to have him working beside me, always ready to put at my disposal his unrivalled knowledge of the whole field of the Institute's activities and his trained judgment as to its best nterests.

During the year the changes within the Faculty have been

s follows: Professor George F. Swain, Professor Harry E. lifford, Professor Fred Wheeler, Associate Professor George . Shaad, and Associate Professor William E. Mott have esigned. The vacant professorships of Civil Engineering, heoretical and Applied Electricity, and Military Science ave been filled respectively by the appointments of Profes- ors Charles M. Spofford, Harold Pender, and Captain Alpha . Easton. Professor William E. Wickenden has been ap- ointed Assistant Professor of Electrical Engineering. The llowing promotions have been made within the Faculty: ssociate Professors Louis Derr, Augustus H. Gill, William . Lawrence, and Arthur G. Robbins have been advanced the grade of full professors; Assistant Professors Harry . Gardner, Samuel W. Prescott, and Charles H. Warren that of associate professors; and Instructor Clarence L. E. oore to that of assistant professor.

In a number of cases these changes have involved the loss instructors who were trained at the Institute and whose rvices to their Alma Mater have been very highly appreci- ed. Such losses are, however, inevitable in a great sci- tific school whose function it is, not only to educate engi- ers and architects, but to train men to impart to other hools the Institute's most effective methods and ideals.

WORK OF THE YEAR.

The work within the Institute during the year is clearly dicated by the heads of departments and other adminis- ative officers in the reports that are appended. It will be en from these that the year has been one of steady prog- s, not marked by any striking modification of the condi- ns or the methods of the previous year. The total num- r of students has risen slightly—from fourteen hundred d sixty-two to fourteen hundred and seventy-nine, the tering class being—with the exception of that of last year the largest in the history of the Institute for more than ten

years. The number of students coming from a great distance gives some measure of the reputation of a school, and is specially significant for this Institute whose fees are relatively very high. The number from beyond the borders of Massachusetts is at present six hundred and twenty-seven. Of these, seventy-nine come from thirty different foreign countries, China and Mexico being the largest contributors. The remaining five hundred and forty-eight are from forty-two states and two territories of the Union, the District of Columbia, Philippine Islands, Porto Rico, and the Canal Zone. The number of graduate students is two hundred, and they represent eighty-four colleges and universities. It is evident from this that our students live in a community whose members have been brought up in widely different conditions. They thus have the opportunity of a liberal education by the simple process of mixing with their fellows. Unfortunately, the conditions under which they live do not make it possible to take advantage of such opportunities to the full.

An important step in the development of the social life of the students was taken last year and referred to in the report of the Acting President. This was the opening of the new Technology Union, designed to serve the purpose of a students' club house. It has continued throughout this year to be the center of social life among the students and has contributed largely to the marked increase of social activities that is referred to by the Dean in his report. The successful management of the dining-room at the Union has proved a problem of considerable difficulty and one that has not yet been solved in a thoroughly satisfactory manner. The health of the students as a whole continues excellent, and it is particularly gratifying to find that their health seems to improve steadily as they stay longer at the Institute. Interesting statistics on this matter are given by the Dean and Medical Adviser; and from these it appears that the very hard work that the Institute demands from its

students is a good thing for them physically as well as mentally.

The most important change in the carrying on of our work during the year has been the establishment of a separate Course in Electrochemistry. The purpose and leading features of this Course are lucidly set forth in the report of Professor Cross.

Besides doing the regular work of instruction, several of the departments have devoted a considerable share of their resources and energies to the conduct of scientific research. This has for some time been a marked feature of the Institute, and it is of the first importance that it should be maintained. Doubtless in various schools many educational sins have been committed in the name of research, but there can be no question that the spirit of research is the very breath of life to a scientific school. The Institute has been peculiarly fortunate in having on its faculty men who recognize this thoroughly; and it is not a little remarkable that many of the most important contributions to *pure* science that have been made within recent years in America have been made by graduates of the Institute of Technology, which on its scientific side is popularly, although of course quite erroneously, supposed to be almost exclusively a school of applied science. It is interesting, too, to note that a number of the gifts recorded in the Treasurer's report are for the prosecution of research. Amongst these is the gift from an anonymous friend for sanitary research work; from a member of the Corporation for research in applied chemistry; from several contributors to the fund of seismological research; from Dr. Charles Weld for research in naval architecture; and from Dr. Noyes for research in the department of physical chemistry. One of the most gratifying of the gifts is that from Mrs. William Barton Rogers, whose interest in and enthusiasm for the Institute could not have been greater when it was founded by her husband nearly half a century ago. The largest item on the Treasurer's list of

gifts is that of over $40,000 from the Alumni Fund. This, of course, has been contributed, not by one individual, but by a large number of the alumni.

RELATION WITH THE ALUMNI.

There have been many proofs during the year of the continued and increasing interest of the alumni in the welfare of their Alma Mater. The contribution towards the alumni fund, to which reference has just been made, was a practical demonstration of allegiance which has greatly helped the Institute at a critical stage of its development. Indeed, but for such support it would have been impossible to carry on the work without a very serious diminution of efficiency. The great Reunion of the alumni in June surpassed anything of its kind in the history of the Institute, both in the magnitude of the gathering and the intensity of loyalty and enthusiasm displayed by those who came. As the success of the Institute must depend in large measure on the attitude of the alumni, any movement that tends to bring about a closer relationship between the alumni and your Corporation must be of interest to this body. During the last year an important change has been made in the constitution of the governing body of the Alumni Association, which has become more truly representative in character. By the new constitution an Alumni Council has been established, to which the Corporation might appropriately refer any question with reference to which an authoritative expression of opinion on the part of the alumni might be desired. This Council may also render great assistance to the administration by considering various problems of interest to the Institute and reporting the views of the alumni as to the best method of dealing with them. At the first meeting of the Council, committees were set up at the suggestion of Dr. Noyes, then Acting President of the Institute, to consider the following questions: the establishment of a camp for the summer school

f civil engineering; the equipment and instruction in re-
rigerating, gas engineering, and aëronautics; the founda-
ion of scholarships to connect the Institute with the more
nportant high schools in this section of the country; the
evelopment of a research laboratory of engineering; the
stablishment of a committee on Student Welfare.

SOCIETY OF ARTS.

With regard to the Society of Arts, I am pleased to be able
) report that there has been a gratifying revival of interest
ı its proceedings. This Society has played a conspicuous
art in the educational development of Boston; but like other
milar societies elsewhere it has suffered in its popularity
y the change of conditions since its foundation. The in-
:rest in science has not diminished; on the contrary, it is
ıtenser and more wide-spread; but science has become much
ıore specialized. This has led to the establishment of nu-
ıerous technical societies dealing with special branches of
:ience, and the proceedings of these societies attract the
ttention and monopolize the time of a large number of those
ho are most seriously interested in science and its appli-
ıtions. Apart from this, there has been a marked falling
f of the "lecture habit" in most communities in which, a
:neration ago, lectures by competent men attracted a great
:al of attention. If the recent revival of popular interest
the proceedings of the Society be maintained, it will, of
ıurse, be an encouragement to continue the work on the
ıes that have been followed so long. Unless, however,
ıis be the case, the Society will doubtless divert its energies
to some different channel. The next few years will there-
re be critical ones in its history.

POLICY FOR THE FUTURE.

As to the future policy of the Institute as a whole, there
ems no call for radical change as regards its educational

methods or its aims and ideals. It has had the great advantage of having been started on a broad gauge and kept thereon by a long succession of broad-minded instructors and administrators. For some time its combination of liberal and professional studies and its emphasis on science as a means of culture were regarded as experiments in the world of education. The experimental stage, however, has long since been passed; and the type of education initiated here has conclusively proved its usefulness. As far then as internal management is concerned our problem presents no peculiar difficulties. We have merely to continue along the natural lines of development and do all we can to secure the best type of instructors and maintain the highest possible standard of scholarship and technical skill. If we do this, we will continue to render a great service to the state and to the country as a whole.

Amongst the features of the Institute that are specially encouraging in the outlook on the future may be mentioned the peculiar devotion of the Faculty and of the alumni. In the short time that I have occupied the office of President I have had several opportunities of observing the readiness with which members of the Faculty sacrifice their financial interests through their belief in, and loyalty to, the Institute. Moreover, the number of the students is very encouraging, especially when we consider the relatively high fees that we are forced to impose in order to maintain our standards of efficiency. Here we have no problem of staying the decline of an institution that is running down, for the number of our students is as large as we can accommodate. What is still more important is that the quality of the students is excellent; for, after all, in an educational mill the great thing is to get good grain. The students that come to us are nearly all young men of character and grit, just of the type for whom careers of usefulness and success can be most confidently predicted. I may add that one of the chief assets of the Institute is the tradition of seriousness of purpose

ıard work on the part of the students. It is certainly ıute to Rogers' wisdom that the school that he founded ucceeded so easily, one might almost say inevitably, ɔiding the more serious problems of discipline, the abuse ıletics, and the various other difficulties that have long pressing so hard on many of the colleges throughout ınd and of late have been causing so much disquietude within and without these colleges. It is scarcely nec- y to say that the prestige of the Institute must prove uable to it in facing the difficulties of the future. It is 'n and respected throughout the world as one of the ːers in the field of education that it occupies, and as ɔf the most successful today in maintaining the highest lards in the training of engineers and of architects. Its uates are eagerly sought for to fill important positions ver the world, and now, as formerly, every head of a rtment reports that far more graduates are applied for can possibly be supplied. Then, although it has not et the financial resources that are needed for its devel- ent, the Institute is fortunate in having large assets in being entirely free from debt.

THE NEED OF FURTHER ENDOWMENT.

mention these encouraging features because I think it that we should all realize that the one thing needful is her endowment to enable the Institute to take up new ɛ and to improve the conditions of the old. This claim new endowment is unfortunately a commonplace of idential reports, but it is none the less pressing because ts commonplace character. It will be seen from the ıurer's report that we have this year a real deficit,—a excess of expenditure over income. This is the case pite of the greatest care in keeping expenses as low as is ːistent with the high standards that we endeavor to main- . Besides this, it has been recognized for long that we

have not sufficient means to develop naturally, and that the quality of the instructors that we can employ must inevitably deteriorate if we cannot meet the increased cost of living by the payment of better salaries. In many respects the salaries that we pay compare very favorably with what is the best practice in this matter in the country. Our peculiar weakness is in our treatment of the middle men, on whom a large share of the burden of teaching falls. These men are eagerly sought for to fill higher positions in similar institutions elsewhere; and, although we should always welcome their promotion, we should be able to get the best of them back if we need their services later; or if we cannot get them, we should be able to get men of equal grade. To make this possible further endowment is indispensable. It is to be hoped that this will come from public-spirited citizens; but it is also, I think, to be hoped that an effort will be made to secure more support in this direction from the state. No one who has looked into the matter can fail to recognize the great service that this Institute has already rendered to the State, and still more the greater service that it can render in the future if not allowed to languish by insufficient support. At present it receives an annual grant of $25,000 from the State of Massachusetts, which is not a twentieth part of its annual expenditure. Such a grant to such an institution seems absurdly inadequate, especially in view of what other states are doing. We have only to look to the western states of this Union to see how differently matters are being dealt with elsewhere; and the zeal for technological education on the part of the state is certainly not confined to this Union. A recent visit to Europe has made it evident to me that many of the states of the old world that have been slow to recognize the needs of the age are rapidly making up for lost ground. It would be peculiarly unfortunate if Massachusetts, which was a pioneer in the matter of state support for this type of education, should be left behind in the race.

THE PROBLEM OF A NEW LOCATION.

The problem of securing increased endowment is not the
ly serious one that confronts us. We must find a new
:ation for the Institute. The need for such a change was
ged in his annual reports by Dr. Pritchett for years, and
:. Noyes last year summed up the matter thus: "There has
)wn up not only amongst your own members, but amongst
the other groups of men connected with the Institute,—
culty, Alumni, and Undergraduates,—a sentiment so
ong that it will be satisfied with nothing less than the cre-
on of a new Institute on a new site." The situation must
refore be familiar to every member of your Corporation,
l it cannot be necessary for me to do more than briefly
apitulate the grounds for the desired change.

'irst.—The present site, although conveniently situated,
ıoisy, dirty, and subject to mechanical and electrical dis-
bances which interfere with its efficiency as an educational
:hine. It is cut up into a number of sections at a con-
:rable distance from one another, separated by busy
ets; and no land is available in the immediate neighbor-
d of any of these sections except at a prohibitive price.

econd.—The present buildings are overcrowded, the need
more room being a constant source of complaint from
ds of departments in their reports. Devices of all sorts
e been adopted to economize space, with results that
far from satisfactory and seriously hamper the proper
elopment of the Institute.

hird.—The buildings are scattered in such a way as to
ssitate a separation of departments, which for conven-
e of teaching should be closely associated.

)urth.—This overcrowding and scattering of buildings
only limits the efficiency of the Institute, but robs it
he outward dignity of a great educational institution.
ıould be part of the education of an engineer or an ar-
:ct to be brought up under conditions that impress him

with the dignity of his profession; the lack of such conditions, not only acts unfavorably on the student, but reacts on the public. It fails to attract their attention to the importance of the Institute and the claim that it has on their support.

Fifth.—The older buildings have reached a stage when repairs of all sorts are necessary and great expense is incurred in their maintenance. In many respects they have grown out of date; for example, they are not ventilated by modern methods.

Sixth.—The newer buildings are mostly temporary in their structure, and are beginning to reach the limit of age for which they were designed.

Seventh.—It is difficult, if not impossible, under the present surroundings to provide properly for the physical and social development of the students.

Eighth.—The unfavorable conditions that exist today will be so aggravated within the next ten years that removal will then be inevitable and the Institute will be forced to a suburban location far removed from the center of the city, —a result which is almost universally admitted to be undesirable.

Ninth.—The expense of making proper provision upon the present site for the development immediately demanded is very large; and although it is less than that of removing to a site, yet the difference is probably more than compensated by the greater ease of securing funds for the execution of a well-considered, consistent plan for rebuilding the Institute upon an attractive location.

Tenth.—In order that the prestige of the Institute may not suffer through the prevalence of the idea that it is resting upon its laurels, and in order to meet the competition arising from the development of similar schools throughout the country, it is important that some decisive and impressive step be taken as speedily as possible. The Institute needs a new site and new equipment, in order to maintain

s position as a scientific school of the front rank and as the ading representative in the world of a characteristic form f combined liberal and professional education.

As to the requirements of a new site, it is obvious that the te should be of sufficient area to make provision for the robable advancement in the next generation. It is diffiılt to see even so far into the future as to say definitely hat this area should be. Having regard, however, to what deemed necessary elsewhere, it would seem that twenty-ve acres is a minimum. Then the location should be worthy the dignity of a great educational institution, whose work ould be recognized as of the very highest importance to e welfare of the state. The site should be such that stuıts' houses or dormitories could be erected near at hand. specially at an institution like this, which draws such a rge number of its students from a great distance, there ust always be a great many who cannot live at home. hatever may be the difficulties in the successful manageıt of students' houses, there can, I think, be no doubt at they are infinitely to be preferred to the cheap lodging uses to which the circumstances of so many of our students ce them to resort. Living in such houses is not only bad the health, but it deprives the student of the social adntages which he ought to reap by being a member of a mmunity so cosmopolitan in its character as is the Instite of Technology. Another requirement of the new site that it should be as accessible as possible from the varis railroad stations in Boston, so as to enable those who nt to live at home to do so. There are already a large mber of these coming to the Institute from all directions ound Boston. It would, I think, be extremely unwise completely change the character of the Institute by forc all its students into dormitories. Lastly, the site should as near as possible to the center of Boston, so that close ıtact might still be maintained with the various profesnal, industrial, and business activities of the city.

A special committee has been engaged during the year in considering the relative advantages and disadvantages of a large number of sites. Many of these are eliminated by consideration of the requirements that have been indicated above. But there are three or four left that would satisfy most of our needs. The problem of final selection will doubtless be affected largely by the consideration of the cost. The financial burden of a change is a heavy one; for the total sum required to rebuild, re-equip, and make growth possible by increased endowment involves millions. The Institute is national in its scope and in its services, and so may reasonably look for help in many quarters. But its chief reliance must probably be on Massachusetts; and the citizens of Massachusetts who are interested in education have many calls on their generosity. It may be said that it is to their alumni that most American institutions look for their chief support; but the alumni of the Institute do not, as yet, form a large or a wealthy body. Most of them are men who have had to make their own way in the world, and this is a process in which time is a very important factor. It is a striking proof of the rapid development of the Institute within recent years that half of its graduates have received their degrees within the last ten years. These men are enthusiastically loyal, and will doubtless help us largely in the time to come; but we cannot reasonably expect very much from them as yet.

I mention all these discouraging features of our situation, not from any feeling of pessimism as to the future; indeed, nothing could be further from the fact. I realize that most of the Institute's difficulties are due to its success and not to its failure, and I believe that a splendid future is assured to it, if, at this critical stage of its history, it does not falter through lack of courage. It seems to me that when the opportunity arises it should sell that part of its property which is unrestricted,—that is, all except the Boylston Street property,—and with the proceeds secure a new site. It should

:n throw upon the public the burden of completing the rchase money of this site, if any complement be required, l of putting up new buildings and improved equipment. e Boylston Street property could be retained for carrying that part of the work that can with the least inconvenience separated from the rest until the time comes when re- ictions upon its use can be removed at a reasonable cost. :h a policy involves some risks; but these are almost as vitable to a progressive educational institution as to a ıgressive business. The question whether the risk is : that can reasonably be taken is, of course, a question for individual judgment. My own opinion is that the risk ıot great, provided only we have the active co-operation ıll those interested in the Institute. It is scarcely neces- y to add that the question of the future location of the titute is one that should be settled as promptly as possi-

It has been before your Corporation for many years. t were settled, the Institute could devote all its energy the really great work of developing its educational re- rces; for, of course, its primary and fundamental prob- s are, and must always remain, educational.

:O-OPERATION WITH NEIGHBORING INSTITUTIONS.

'f the larger questions of future policy not already touched n in this report, probably the most important is the stion, how far can we profitably co-operate with other cational institutions in our neighborhood? Waste of rt is regrettable anywhere; in educational institutions more than regrettable,—it is a deliberate sin against the t. Every educated man must know that the record of gress is largely the history of the elimination of waste; every institution of learning has the duty imposed upon : avoiding waste wherever possible. In our own field of ınological education it does not require any remarkable ers of prevision to foresee that the burden of keeping

up to the growing needs of the day will become heavier in each department. Then as science advances more and more and gradually invades new territories, as inevitably it must, the field of activity of a school of applied science will be greatly extended. Thus an institute of technology will have to cultivate a wider area and cultivate it more intensely than in the past. All this will make the task of conserving all its powers as much as possible, a still more imperative duty. The practical questions are, have we now reached the stage when coöperation is expedient, and, if so, how can this coöperation be most effectively undertaken? After a preliminary survey, the only question in my mind is as to the best means of coöperation. This is a problem of some difficulty and delicacy and one that cannot be solved satisfactorily without care and patience. At present I can only say that I shall give it my earnest attention in the immediate future.

RICHARD C. MACLAURIN.

Reports of Administrative Officers.

EPORT OF THE SECRETARY OF THE FACULTY.

he reports from the various departments of the Insti-
e will be found to contain information in regard to the
owing matters which have received Faculty attention
l approval during the past school year: changes in the
edule of studies of Courses III. (Mining Engineering and
tallurgy) and IV. (Architecture), in each omitting for-
n language study above the first year, also a revision of
schedule of studies in Course XI. (Sanitary Engineering);
forming of a distinct Course in Electrochemistry, num-
ed XIV., formerly option 3 of the Course in Physics;
withdrawal of the undergraduate Course in Landscape
hitecture; and the authorization of student conferences
ting to the subject of Physics in the second year.

The School of Engineering Research as a distinct feature
the Institute has been discontinued, and all matters re-
ing to its courses of study and candidates for the degree
Doctor of Engineering are now referred to the Committee
Advanced Degrees and Fellowships.

The students' records have been, as usual, carefully con-
ered, those of the first and second year students six times
ing the year, and those of the third and fourth years
ce. Standing committees of the Faculty review the rec-
ls of students of the second and third years and report
the Faculty. On recommendation of these committees
se whose records are low are referred for advice to the
an or to some other member of the Faculty. The policy
the past years has been continued, advising or requiring
hdrawal in the case of those who remain in low standing,

and who seem to be unfitted to pursue courses of study at the Institute. In January, 1909, twenty-two students were advised, and thirty-three required to withdraw, and in June, 1909, thirty-eight were advised, and thirty-six required to withdraw.

There are attending the Institute thirty-nine students who have been admitted to graduate courses of study, nine of these being candidates for the degree of Doctor of Philosophy, two for that of Doctor of Engineering, and twenty-two for that of Master of Science. Two non-resident fellows and four resident fellows have been appointed for the year 1909–10.

One hundred and eighty-two students have been admitted to undergraduate courses of study on credentials from other colleges, one hundred and thirty-six having already received a degree from their former college.

In June, 1909, nineteen candidates were recommended for the degree of Master of Science and one hundred and thirty-two for the degree of Bachelor of Science.

Fellowships and graduate scholarships to the amount of $5,200 have been awarded to seventeen students. One hundred and ninety-nine undergraduate students have received scholarship assistance from Institute funds to the amount of $22,687.50.

ALLYNE L. MERRILL,
Secretary of the Faculty.

REPORT OF THE DEAN.

The past year has been one of marked changes on the social side of the life of the undergraduate. At the beginning of the year the new Union was opened, and its management placed largely in the hands of the undergraduates. Three committees were placed in charge: the House Committee, Dining-room Committee, and the Entertainment Committee.

The work of the Dining-room Committee was necessarily

e most difficult task, and although the total receipts of e dining-room did not cover the total expenses of the year, d although there were at times justifiable criticisms of e food and service, all praise should be given to the efforts the members of the Dining-room Committee to do their rk in a satisfactory manner. It was, perhaps, too much expect that undergraduates should be able at once to et the inherent difficulties connected with the manage- nt of a large restaurant. The attendance of students to the end of the year was larger than it has ever been at y previous lunch room, and the special dinners furnished the evening to student organizations were larger in num- r, and better attended, than in any former year.

At the beginning of the present school year, however, ne changes were made in the management of the Union, hich we trust will be of benefit in remedying the defects ted in the previous year. The responsibility of the man- ement of the dining-room has been placed on the Presi- nt's Assistant, Mr. Maurice R. Scharff. The student mmittees are continuing as heretofore, the Committee on e Dining-room giving assistance to Mr. Scharff in the fur- erance of his plans. The Dean still retains the position Chairman of a general Union Committee, made up of idents from the three upper classes.

The work of the Entertainment Committee gave notice- le satisfaction to every one. On almost every Friday even- g of the year some form of entertainment was furnished all students who were interested to attend. Many in- esting and distinguished speakers kindly offered their vices to this Committee. There was an entertainment ven on Christmas Eve which was largely attended, and er the intercollegiate track games in the spring (held at e athletic field), all visiting collegians were invited to attend informal gathering at the Union.

The effect of the Union in promoting a more general ac- aintance among the undergraduates is noticeable to any

one who is familiar with student life at the Institute. There is now a very strong desire on the part of the undergraduate body to bring about an improvement in all the conditions of social life at the Institute. A small body of students may, from time to time, commit acts that call for public criticism, but the general tone of student life has improved. In connection with this effort of the students to help in the development of a social life, consistent with the demands of our exacting curriculum of study, we should note the action of the Institute Committee (which is now an active body of the undergraduates with a membership truly representative of the different classes and organizations) in recommending to the students the adoption of a point system, which would prevent any student from entering into too large a number of outside activities. This recommendation of the Institute Committee is spoken of in President Noyes' report of last year. Its general and hearty adoption by all students has now taken place, and a record of offices held by individual students is closely scrutinized by the Committee.

Another important work carried on by undergraduates has been the compilation and publication of a book, which gives a concise and complete account of life at the Institute from a student's standpoint. It is called "Concerning the Massachusetts Institute of Technology." This book was completed in the fall of this year and has now been distributed free among all the undergraduates and to students of preparatory schools. The expense of the publication has been covered by subscriptions and advertising cards from the alumni. This book is a fair exhibition of the attitude of the undergraduate to-day towards both the scholastic work and the social life of the Institute.

The Union has done much to promote sociability among undergraduates. Its management has forced a desirable responsibility on student committees. The organizations in connection with the different courses of instruction encourage an interest in professional work, but it seems de-

:able that there should be some general society of upper-
ass men, which has for its basis excellence in scholarship.
t almost all of the larger universities and technical schools
ere are such honorary societies, based on scholarly attain-
ents, and their effect is very encouraging to the earnest
udent.

The work of the first-year instructors in the Mathematical
id English departments, in reaching the individual needs
first-year students through their conferences, has been
ccessful, and it has made it possible to a great extent
do away with the assignment of other officers of the Fac-
ty as special advisers to first-year students.

Consultations with individual students have now become
e chief work of the Dean. During the past year one hun-
ed and fourteen students were sent to him by vote of the
iculty, and a large number who were not referred directly
the Dean consulted him of their own accord. These
rsonal interviews, and work on the committees, now take
) the greater portion of his time, and work which originally
is done in this office is being transferred to the office of
e President's Assistant. The President's Assistant now
s entire charge of the employment of undergraduates.
e also inspects the room and boarding-house list and has
printed register of rooms for consultation by all students.

Compulsory physical training for first-year students, which
is inaugurated last year, proved to be a good thing in every
ay. The conduct of the instruction was in charge of Mr.
infield C. Towne and Mr. H. A. Bruce. At the end of
e year Mr. Towne resigned as instructor, his work as
torney-at-law requiring his full time. Mr. Towne has
en employed as instructor in the Gymnasium for six years.

accordance with a recommendation made by Mr. Towne,
alf-story was added to the locker room of the Gymnasium,
d three hundred new steel lockers were put in position, the
l lockers being turned over to the Advisory Council on
hletics for use at Technology Field.

Through coöoperation with the Alumni Advisory Council on Athletics an arrangement was made this year to place the gymnasium work in the charge of Mr. Frank M. Kanaly, who is also the coach for the athletic teams. Mr. Kanaly will be assisted by Mr. Joseph McNamara, who has for many years been connected with city gymnasiums.

The course in Physical Training required in the first year, consists of four lectures on physical training and personal hygiene given during the first four weeks of the term, of physical examinations involving the usual anthropometric measurements and strength tests made near the beginning and near the end of the school year, and of regular class work at the gymnasium two hours a week for twenty weeks during the winter months. Each student receives a record in this subject based upon his attention to the work and the improvement shown by the second physical examination. As in other subjects students who failed to do satisfactory work are required to continue the subject another year.

First year students may, if they prefer, substitute track work for the class work in the Gymnasium provided they pass a satisfactory physical examination, but in that case they have to report regularly to the track coach and are marked upon their work.

This innovation proved successful from the first and fully justifies its continuance. The students have taken great interest in the work and much better results have been obtained than ever before.

Physical examinations of the Freshmen began Oct. 4, 1909, and three hundred and sixteen members of the class had been examined and charted on November 8.

Of the class, thirty-three have been excused from the training on account of physical ailments and being over twenty-one years of age. Forty-five members were allowed to substitute track athletics for the gymnastics, and are required to report twice each week with the further requirement of making one of the practice periods Saturday afternoon.

The arranging of the classes commenced November 8 and as completed November 12 and actual gymnastic instruc-on began November 15. One class is held each day ex-pt Saturday and all classes are from 3.10 to 4.10. Each udent attends exercises two hours per week, but on two fferent afternoons.

The method employed is to have one instructor carry on listhenics while the other instructor notes the character individual work. At close of the calisthenics each in-uctor takes a division of the class on the apparatus and orks until ten minutes of the hour period when recreative mes are played for the remaining time.

ATISTICS OF ILLNESS FOR THE SCHOOL YEAR 1908–09.

Fourth-year Class.

There were three hundred students in the fourth-year class. Of ese, fifteen were reported ill during the school year 1908–09. Classi-l by illnesses, there were the following cases: appendicitis, 2; diph-eria, 1; grippe, 1; hernia, 1; mumps, 1; rheumatism, 1; trouble h eyes, 1; typhoid fever, 1; not specified, 6.

Third-year Class.

In this class there were three hundred and seventy-seven students, whom twenty-nine were reported ill during the year. The follow-cases were reported: appendicitis, 1; blood poisoning, 1; cold, 2; ppe, 4; inflammatory rheumatism, 1; jaundice, 1; mumps, 2; eumonia, 1; surgical operation, 3; tonsilitis, 2; typhoid fever, 1; erated tooth, 1; not specified, 9. There was one death in this class, t of Mr. E. K. Harvey, who died on Oct. 27, 1908, of typhoid er.

Second-year Class.

This class numbered three hundred and seven students, of whom rty-seven were reported ill during the year. There were the fol-ing cases: abscess, 1; bilious attack, 1; broken wrist, 1; cold, 2; rrhœa, 1; fever, 1; grippe, 2; jaundice, 1; quinsy sore throat, 1; eumonia, 2; surgical operation, 1; tonsilitis, 1; not specified, 22. ere was one death in this class, that of Mr. G. E. Livingston, who d on March 7, 1909.

First-year Class.

The first-year class numbered three hundred and fifty-eight students. Of this number sixty-three were reported ill during the year. Classified by illnesses there were the following cases: abscess, 2; acute rheumatism, 1; acute urethritis, 1; appendicitis, 1; blood poisoning, 2; bruise of leg, 1; burn on hand, 1; chronic synovitis, 1; cold, 5; diphtheria, 2; dislocated elbow, 1; fractured nose, 1; grippe, 5; influenza, 2; injury to eye, 1; injury to leg, 1; injury to toe, 1; iritis, 1; jaundice, 3; mercuric poisoning, 1; sore throat, 1; sprained ankle, 3; tonsilitis, 2; toothache, 1; trouble with eyes, 2; typhoid fever, 1; not specified, 19. There was one death in this class, that of Mr. A. E. Joyner, who died on May 15, 1909, of pulmonary tuberculosis.

SUMMARY.

	No. in Class.	No. Ill.	No. of Deaths.
Fellows and Graduates	32	0	0
Fourth Year	300	15	0
Third Year	377	29	1
Second Year	307	37	1
First Year	358	63	1
Total	1,374	144	3

ALFRED E. BURTON,
Dean.

REPORT OF THE MEDICAL ADVISER.

There have been no important changes in the routine of the medical work at the Institute in the past year. Consultation hours were held on two afternoons a week throughout the year; and as usual the time was fully occupied by the students and the time of consultation had frequently to be extended to accommodate all those who came for advice. The average extra time needed was thirty-five minutes more than the appointed hour.

The following table gives the number of office visits made and the number of students seen. A few figures of previous years are given for comparison:—

	1907.	1908.	1909.
:al number of office visits made	409	318	432
:al number of different students seen	196	184	318
:atest number of students seen per day			13
ıst number of students seen per day			3
:rage number of students seen per day			7
mber of students making more than one visit			85

The number of students coming to the medical office has :atly increased in the past year, averaging two or three)re students at each consultation hour throughout the ar. The increase is almost entirely due, I think, to the w requirements for Physical Training and the necessity a doctor's certificate to explain absence from Physical aining and Military Drill on account of physical disabil- or acute illness. This increased work has demanded ry little extra time and has proved valuable in several ys, namely: It has largely prevented absence from Drill d Physical Training without cause; it has put me in touch th the men at the Institute who are less robust than the erage; it has brought additional men to see me promptly ıo needed medical advice on account of acute illness.

The large majority of men found it necessary to make ly a single visit; only three men made more than five ;its; and seven was the largest number made by any one ın. These facts speak well for the general health of the ıdents.

I still find it necessary to point out to the less vigorous :n the necessity of taking at least a few weeks' vacation summer at the end of the spring term and before the fall :m begins. It seems very desirable that the officers of ;truction who have an opportunity to advise the men about eir summer work should emphasize the necessity of some ;t at each end of the summer. Each year I find a certain mber of men who get tired and whose work suffers early the fall term from lack of this rest.

A great variety of illnesses were treated at the medical ice, the most numerous being digestive disturbances, dis-

eases of the nose and throat, skin, and surgical diseases. About ten men suffered from severe illnesses, such as appendicitis, diphtheria, jaundice, pleurisy, and disease of the kidney, and some of these were sent to the Massachusetts General or Boston City Hospitals. A small number of students were referred to specialists for the treatment of the eye, ear or skin.

In addition to my work at the Institute office I have seen about fifty men at my private office and a much smaller number at their residences. Ten men were examined for the United States Civil Service, and I have many opportunities to help men decide whether or not they are physically fit for certain athletic sports.

The cases of contagious disease among the students have been as usual few in number, probably owing to the scattered residence of the men.

Two talks on personal hygiene were given by the Medical Adviser to the Freshman class covering the following subjects: Bathing, exercise, care of the eyes, the use of tobacco and alcohol, minor ailments, the emergency treatment of injuries, and also the prevalence and danger of venereal disease.

The fact that from six hundred to seven hundred men are living away from home in Boston and its suburbs under conditions which make hospital treatment desirable or imperative, in case of any illness which confines them to bed for more than a day or two, and that at least forty or fifty students suffer from such illness each year, makes it worth while to consider the possibility of a small Institute hospital or infirmary to care for our own students. The Tech man who is sick in a lodging house, away from home, demands our sympathy and care, and it is of course more agreeable for him to spend the time during his illness and convalescence in a small hospital with a few fellow-students than in a general hospital. This plan of a college hospital has been very successfully carried out at many colleges and universities

I am occasionally asked why we do not have one at the
titute.

'he conditions at the Institute are somewhat peculiar
I think do not warrant the attempt to raise funds for
purpose at the present time. We have no group of
mitories, and the residence of the men is scattered. A
siderable number of our students come from Eastern
ssachusetts, and a large proportion of these live at their
1 homes, and would not be likely to use such a hospital.
e expense of renting or purchasing, equipping and run-
g such a building, in or near enough to the city to be
ilable, would be large. This is especially true since about
-third of the cases cared for would be contagious diseases
phtheria, scarlet fever, measles, etc.). It seems unwise
go to this expense until the permanent location of the
titute is definitely settled.

)n the other hand, it must be remembered that the pres-
plan is really quite satisfactory. The hospitals in Boston
of the highest grade and very accessible to the students.
e Institute has one or two free beds at the Massachusetts
neral Hospital. There is never any delay in admitting
dents who need hospital care, and there is never any
asion for a poor student to pay for treatment if he can-
afford to, whether or not the Institute beds are filled.
ere is little or no necessary expense to the student except
contagious cases.

When the Institute moves to a new location out of town,
d has a compact group of buildings with dormitories, and
st of the students living together, an infirmary will be
very necessary and desirable part of the plant, and an
mirable object for endowment.

FRANKLIN W. WHITE,
Medical Adviser.

REPORT OF THE LIBRARIAN.

The total number of books and pamphlets placed upon the shelves of the Library during the academic year ending September 30, 1909, is 6,423, an increase of 1,860 over the previous year. The following table shows the source of these accessions:

TOTAL ACCESSIONS, 1908–1909.

By Purchase	1,466
By Binding	1,321
By Gift, volumes	2,528
By Gift, pamphlets	1,108
Total	6,423

The cost of the purchase of books and periodicals and of placing them upon the shelves, exclusive of salaries, as shown by bills approved by the Librarian, amounts to $8,052.58. The items of expenditure may be classified as follows:

BILLS APPROVED, 1908–1909.

Books and Binding	$5,996.57
Periodicals	1,826.12
Supplies	322.26
	$8,144.95
Less cash received from sale of duplicates	92.37
Total	$8,052.58

The Libraries of the Institute now contain 86,554 volumes and 23,819 pamphlets and maps, representing an estimated investment of capital of $182,226.37. Each year a certain number of entries are cancelled in our record of accessions, either because of the loss or destruction of some books or owing to the binding up of several volumes into one. After deducting such items, the net increase in the Libraries of the Institute has amounted during the year to 4,752 volumes, 1,090 pamphlets, and 135 maps; a total increase over the previous year of 1,556 items.

he way in which these accessions have been distributed ıe several Libraries, together with their cost, is exhibited ıe following table:

E OF THE NET INCREASE WITH THE COST OF THE SAME DURING THE YEAR 1908–09 AND THE TOTAL CONTENTS OF THE LIBRARIES OF THE INSTITUTE SEPTEMBER 30, 1909.

LIBRARIES.	NET INCREASE.				TOTAL CONTENTS.	
	Volumes.	Pamphlets.	Maps.	Cost.	Volumes.	Pamphlets and Maps.
ral Library:						
neral	60	131	—	$241.05	7,454	5,209
glish	—1*	—4*	—	20.62	3,498	40
ilitary Science	—	—	—	—	367	9
alker Memorial	—	—	—	—	485	—
her Departments	1	—	—	17.97	49	1
otals General Library	60	127	—	$279.64	11,852	5,259
chitecture	186	7	—	328.76	4,341	268
ology	157	125	—	389.37	3,694	894
emistry	484	232	—	1,061.57	11,779	2,427
ectrical Engineering	245	15	—	456.80	1,703	93
gineering	553	309	—	1,158.49	14,929	5,332
eology	291	59	110	258.13	3,999	3,112
istory and Economics	1,690	58	—	414.08	14,348	3,809
argaret Cheney Room	117	2	—	20.10	793	15
athematics	126	25	—	350.08	2,037	286
ining	271	25	25	336.01	5,035	787
odern Languages	82	—	—	66.21	1,845	56
aval Architecture	204	49	—	321.98†	1,556	193
ysics	286	57	—	555.32	8,643	1,297
otals	4,752	1,090	135	$5,996.54	86,554	23,819

During the past academic year the publication of the *hnology Quarterly* was discontinued, and, therefore, the ge number of periodicals which had previously been re- ved in exchange for the Quarterly could no longer be imed in that relation. A number of societies and editors magazines, however, have continued to send their pub- ıtions to the Library in exchange for the Bulletins of the

* Decrease. † Including gifts from Dr. Weld.

Institute. For many others it was necessary to subscribe in the usual way. That has made requisite a change in the usual form of the table of periodicals, and all periodicals now received as exchanges are listed as gifts.

The total number in the present table is 1,057, which is 60 less than the number shown in the previous year. This decrease is partially due to the discontinuance of some serials that were not desired, but more to the elimination from our list of gifts of periodicals which had ceased to be sent to us regularly, and for which there was no demand.

The following table shows the total number of periodicals and other serials received for the several Departments and the estimated cost:

TABLE OF PERIODICALS AND OTHER SERIAL PUBLICATIONS RECEIVED DURING THE YEAR 1908–09 CLASSIFIED BY DEPARTMENTS AND METHOD OF PAYMENT.

LIBRARIES.	Number Received.				Estimated Cost.		
	Gifts.	Charged to Department.	Periodical Account.	Totals.	Department Account.	Periodical Account.	Totals.
General	60	15	34	109	$42.47	$115.49	$157.96
Architecture	8	2	30	40	18.20	139.08	157.28
Biology	20	16	37	72	67.61	271.48	339.09
Chemistry	38	46	35	119	191.24	234.18	425.42
Electrical Engineering	6	13	20	39	39.70	82.89	122.59
Engineering	102	66	67	235	209.58	258.90	468.48
Geology	26	6	17	50	30.80	98.87	129.67
History and Economics	68	49	42	159	104.26	123.73	227.99
Margaret Cheney Room	—	6	—	6	17.30	—	17.30
Mathematics	4	7	16	26	22.73	77.17	99.90
Mining	40	11	27	78	38.12	120.67	158.79
Modern Languages	4	—	18	22*	—	74.10	74.10
Naval Architecture	9	12	6	27	59.99	16.91	76.90
Physics	29	15	31	75	69.95	141.80	211.75
Totals	414	264	379	1,057	$911.95	$1,755.27	$2,667.22

The amount of work accomplished during the year in the office of the Librarian is well shown by the number of cards added to the catalogue, which is nearly double the number added during the previous year, the total number added being 10,785, so that the General Catalogue now consists

* 10 kept in the General Library.

102,987 cards; and the total of the Departmental Libraries ›uld add another 100,000.

The total number of orders issued for the purchase of new oks has been 1,337; and 1,718 orders have been issued for nding; in both cases an increase over the number of the evious year.

It is not possible to keep an accurate account of the use of e Libraries. Probably the greater part of the books used e consulted in the reading rooms; nevertheless, there is a ·ge number of books taken for home study and, where ssible, record has been kept of these. The following table ows the data available:

CIRCULATION.

General Library	1,417
Architecture	1,864
Chemistry	1,958
Engineering	1,600
Mining	1,049
Naval Architecture	759

The condition of the shelves has become more crowded an ever, but this congestion has been relieved in a meas- e in some of the departments. In the Engineering Library decided increase in the size of the library room has been ıde by moving a partition and including a room formerly cupied by the assistants in the Civil Engineering Depart- ent. In the Chemical Library certain sets of serials have en moved to shelves in Professor Talbot's office, thus ıking room for books more frequently used in the library. the Biological Department, the congestion has also been lieved by taking certain classes of books and placing them the professors' offices. This is a very inconvenient ar- ngement, but it is the best that can be done under the ·cumstances.

The General Library has been kept open in the evening usual, and the total attendance has been, between five and ven o'clock, 1,273, and between seven and ten o'clock, 739, ıking an average of 7.5 and 4., respectively.

In the previous report of the Librarian mention was made of work then in progress upon a subject catalogue for the Engineering Library. This work was successfully completed by Miss Winn, the Assistant-in-Charge, well within the year covered by this report.

The most noticeable gift received during the year was that of the economic library of General Francis A. Walker, formerly president of the Institute. This library, consisting of 1,336 bound volumes, was presented to the Institute by Mrs. Walker. It has been catalogued and placed upon the shelves in the Library of History and Economics. As a mark of appreciation of this gift a special book plate was engraved and inserted in each volume.

Mrs. Rogers has continued her generous gifts to the Library of the Institute.

Other gifts especially worthy of mention are a collection of seventy-one volumes on Naval Architecture from Rear-Admiral Philip Hichborn, including thirty volumes of the Transactions of the Institution of Naval Architects and five volumes of the Transactions of the Society of Naval Architects and Engineers; from the library of Fred B. Stevens, Jr., '08, thirty-two volumes on engineering subjects; from Mr. Levi L. Willcutt of Brookline, seventy-one volumes of the American Architect; from the heirs of Charles H. Parker a part of the Alfred Greenough collection, consisting of fifty-three volumes on architectural subjects; from Mr. Arthur Winslow, '81, one hundred and fifty-six volumes on geological subjects; from Mr. Stephen Badlam, '00, one hundred volumes, chiefly books on general science, physics, chemistry, and marine engineering, which had formed part of the libraries of his father and grandfather; from Mrs. H. S. Hall, sixty-five volumes on chemical and mining subjects from the library of her late uncle, Lyman Nichols.

From Dr. Gustavus Hinrichs we have received three books of his on theoretical chemistry; from Hollis French, '89, three very interesting old editions of works by Robert Boyle;

n Henry A. Fiske, '91, three copies of Crosby and Fiske's andbook of Fire Protection."

)r. Charles Goddard Weld has continued his gift of a d for the purchase of books for the library of Naval :hitecture, and from this we have purchased thirty-one umes.

'rom members of the faculty we have received a number :heir works. Professor G. A. Osborne presented a copy of "Differential and Integral Calculus"; Professor A. A. yes and Professor S. P. Mulliken, their "Laboratory Ex-iments on the Class Reactions of the Organic Substances l Their Identification"; Professor G. L. Hosmer, his book "Azimuth"; Professor A. H. Gill, his "Handbook of Analysis"; Professor Louis Derr, his book on the "Di-t Current Motors"; Professor C. R. Cross, Jeaffreson's ife of Robert Stephenson" and Hobart's "Electric Mo-s"; Professors F. S. Woods and F. H. Bailey, the second lume of their "Course in Mathematics."

Among other gifts are: from the Editor of the Technique, 'echnique" for 1909; from Gardner Tufts Voorhees, '90, :opy of his work on "Refrigerating Machines"; and from :orge Lansing Raymond of Washington, D.C., a set of ; works, consisting of nine handsomely bound volumes.

ROBERT P. BIGELOW,
Librarian.

REPORT OF THE REGISTRAR.

This report with its tables is based, as is the custom, upon e registration on the first day of November. The regis-ıtion this year is again larger than that of the past year, e number having risen from 1,462 to 1,479.

Omitting the research associates and assistants and those ıo are announced annually as lecturers, the total number members of the instructing staff, as shown by the Cata-

logue this year, is 210; including all there are 241. Not taking into account the research associates and assistants and those who are announced annually as lecturers, the ratio of members of the instructing staff to students in attendance at the Institute is one to seven. Ten years ago this ratio was one to eight and eight-tenths.

Even though the total number is greater this year, the numbers in the classes of the four years are slightly smaller excepting in the case of the second year, where there is a considerable gain. For a number of years the classes have grown smaller as they replace the class next advanced except as the first year class takes the place of the second year class. Here there seems to be for several years a gain instead of a loss. The number of students above the fourth year, resident fellows and other candidates for the advanced degrees, has risen from 26 to 31. This is also a gain over the year previous.

The number of new students entering this year, while not quite as large as the number of new students last year, is, however, with the exception of that year, the largest for more than ten years. The new students are 39 per cent. of the total. Last year this proportion was 41 per cent.

The number of regular students relatively to the special students is also larger this year; last year 65 per cent. were regular while this year 69 per cent. of the students are in regular standing. While there are 31 per cent. of the students not in regular standing, it does not mean that all of these students are not, either actually or prospectively, candidates for the degree. A student is regular when he has a clear record in all of the subjects required up to the point of his connection with the Institute; a student may be special either because he has not fulfilled these requirements, or because he is simply taking a few subjects or less than full work.

The students of the Engineering Courses, regulars and specials, are 83 per cent. of the students of the upper three

rs, those in the Scientific Courses are 7 per cent., while se in Architecture are 10 per cent. Those in the first r have not elected their professional course and cannot er in this calculation. The per cent. of those taking ntific Courses has dropped slightly, and the per cent. students taking the Course in Architecture has risen. greatest gain in any Course is that in Architecture; number has risen from 85 to 104. There are other gains Civil, Mechanical, and Sanitary Engineering, with a ht drop in Mining, and Electrical Engineering. This r, for the first time, statistics are gathered for the Course Electrochemistry, recently set apart from the Course in sics. The number, therefore, of students counted in the rse of Physics is less than usual. A continuous gain the last four years has been made by the Courses in Chemi- and Sanitary Engineering, and the number in Sanitary gineering has almost doubled in the past four years, and ow 60.

count has been made of the number of students pur- g certain leading branches of study and it is found that t to the number of individuals registered for Mathemat- the largest number of students is in English. The num- s of students taking Chemistry and Physics follow closely. The number of students at the Institute who are gradu- s of this or other colleges is 200; they come to the titute from 84 colleges and universities. The largest nber coming from any one college or university is 17 from le. The others sending 10 or more are Dartmouth, 10, rvard, 14, and the U.S. Naval Academy, also 14. This r the number of new students from other colleges is greater n last year; 183 compared with 170. The largest group new students from other colleges entered the second year, ile last year, by a large majority, the greatest number ered the third year. The number of these new students o come to us after having spent four years in another lege is again larger than the number of such students

entering after three, two or one year at their previous college. These 183 members from other colleges are 32 per cent. of the new students, while the number from other colleges last year was 27 per cent., and this was a large gain over the year previous to that.

The number of students who are registered now in the regular Five-Year Courses has risen again materially; and for the first time there are students regularly registered for the Five-Year Courses covering the work of two professional departments. This number of five-year students now is not confined so generally to the Engineering Courses as has previously been the fact, but more have elected the five-year scheme for the Courses in Science. The combinations this year of two Courses are: Civil and Sanitary Engineering, Mechanical and Electrical Engineering, Mechanical Engineering and Naval Architecture, and Electrical and Chemical Engineering.

The number of women students is lower than it has been for a number of years, there being only eight women at present at the Institute. Two are taking special work without course classification. In Architecture there are three women students, one regular and two specials; in Chemistry two, one regular and one special. There is also one special woman student in Biology.

Of the students who were admitted to the Institute this year on the basis of entrance examinations, there is a slight gain in the percentage of those who were admitted clear. There was also, this year, a larger per cent. of first-year students who were admitted, not on the basis of entrance examinations, but either on certificates of other colleges conferring degrees or on the basis of their age or technical experience. Of those who have passed the entrance examinations, a larger number than last year have not entered the Institute.

Last year there was a noticeable rise in the average age of first-year students at entrance. That age was 19 years

one month and for ten years previous to that it had not
eded 18 years and 11 months. This year, again, while
average age was not as great as it was last year, it was
ears at entrance, almost one month less than the average
of the previous first year class. This average age may
lue to the fact of the relatively large number entering
n other colleges.

he class that was graduated from the Institute last
e had, just as the previous class, a relatively large number
tudents who had attended other colleges, and the num-
has risen from 60, two years ago, to 81. This year the
portion was more than a third of the total number grad-
ing, and of this portion more than half hold a college
ree. The age of the graduating class was one month
ater than last year. It was 23 years and 1 month, but
average age at graduation has been as high as 23 years
three months. The 233 graduates of last year raised
total number from 4,128 to 4,361. Half of this number
e graduated within the last ten years, or since 1899.

he homes of our students from this country are in
ty-three states and two territories, the District of Colum-
, Philippine Islands, Porto Rico and the Canal Zone.
rth Carolina, Idaho, Nevada and Oklahoma have no
resentatives. Delaware and South Carolina are rep-
ented, whereas last year no one came to the Institute
m these States. There has been very little change in
relative distribution of the students among the North
antic, South Atlantic, North Central, South Central
l Western Districts of our country. There has been a
ght numerical drop from 51 to 44 students from the South
lantic district and a slight increase in number from the
rth Central, the South Central and the Western dis-
cts. The number from the North Atlantic district is
merically greater by ten than last year.

The number of foreign students has risen, and the num-
r, 79, is within one of the greatest number of foreign stu-

dents we have ever had. Thirty foreign countries are represented by these students, and China with its 11 and Mexico with its 10 send more than any other two countries. Alberta, Bulgaria, New Zealand and Switzerland send students this year, and are countries that have not been represented for the past seven years.

The number of Massachusetts students has increased again; it has risen from 839 of last year to 852 this year, making 57.5 per cent. of students, which is a slight gain over the past three years. The number of towns sending students to the Institute has increased from 128 to 135. Of the Massachusetts students, 84 per cent. are from Suffolk or the counties adjoining. Boston and the cities or towns bordering the city send 51 per cent. of the students of this state, but this amounts to less than 30 per cent. of the total student body. Last year the percentage of Massachusetts students was slightly greater in the non-engineering Courses than in the engineering Courses. The case this year is reversed.

The registration of 215 of the past Summer School is lower than last year. The ratio of students from other colleges taking work in the Summer School, was, however, greater this year. Work was anticipated to a larger extent than in the summer of 1908, and more generally in Mechanic Arts, Descriptive Geometry, Architectural Design, Modern Languages, Mechanical Drawing, and Surveying, than in the other subjects that were given.

The amount of scholarship assistance given during the school year of 1908–9 was $22,687.50. The total number of undergraduate students assisted from Institute funds was 199. In addition to this, 73 students were aided by the State, of whom 47 were not aided by the Institute; this made a total of 246 students receiving scholarship assistance, or 16.8 per cent. of the total number of students at the Institute.

The statistics from which these conclusions are drawn are printed on the following pages.

THE CORPS OF INSTRUCTORS.

	1906–07.	1907–08.	1908–09.	1909–10.
sors	39	43	44	44
ate Professors	18	18	18	14
ınt Professors	21	25	33	32
aculty	78	86	95	90
ctors	69	72	62	69
ınts	52	52	50	51
	121	124	112	120
rch Associates	8	8	6	12
rch Assistants	3	3	1	1
	11	11	7	13
rers	31	32	31	18
'otal	241	253	245	241

STUDENTS BY CLASSES.

Class.	Regular.		Special.		Total.	
	1908.	1909	1908.	1909.	1908.	1909.
ent Fellows	3	4	—	—	3	4
Candidates for advanced rees	23	29	—	—	23	29
h Year	199	224	146	116	345	340
Year	210	191	155	144	365	335
d Year	190	228	151	167	341	395
Year	323	318	61	58	384	376
'otal	948	994	513	485	1,461	1,479
esident Fellows	—	—	—	—	1	2

EARLY REGISTRATION SINCE THE FOUNDATION OF THE INSTITUTE.

Year.	No. of Students.	Year.	No. of Students.	Year.	No. of Students
66	72	1880–81	253	1895–96	1,187
67	137	1881–82	302	1896–97	1,198
68	167	1882–83	368	1897–98	1,198
69	172	1883–84	443	1898–99	1,171
70	206	1884–85	579	1899–00	1,178
71	224	1885–86	609	1900–01	1,277
72	261	1886–87	637	1901–02	1,415
73	348	1887–88	720	1902–03	1,608
74	276	1889–98	827	1903–04	1,528
75	248	1889–90	909	1904–05	1,561
76	255	1890–91	937	1905–06	1,466
77	215	1891–92	1,011	1906–07	1,397
78	194	1892–93	1,060	1907–08	1,415
79	188	1893–94	1,157	1908–09	1,461
80	203	1894–95	1,183	1909–10	1,479

GRADUATES BY YEARS AND COURSES.

Year.	Civil Engineering.	Mechanical Engineering.	Mining Engineering and Metallurgy.	Architecture.	Chemistry.	Electrical Engineering.	Natural History or Biology.	Physics.	General Course.	Chemical Engineering	Sanitary Engineering.	Geology.	Naval Architecture.	Electro-Chemistry.	Total.
1868	6	1	6	–	–	–	–	–	1	–	–	–	–	–	14
1869	2	2	–	–	1	–	–	–	–	–	–	–	–	–	5
1870	4	2	2	–	1	–	–	–	1	–	–	–	–	–	10
1871	8	2	5	–	2	–	–	–	–	–	–	–	–	–	17
1872	3	1	5	–	3	–	–	–	–	–	–	–	–	–	12
1873	12	2	3	1	7	–	–	–	1	–	–	–	–	–	26
1874	10	4	1	1	–	–	–	–	2	–	–	–	–	–	18
1875	10	7	6	1	1	–	–	1	2	–	–	–	–	–	28
1876	12	8	8	–	5	–	2	3	4	–	–	–	–	–	42
1877	12	6	8	4	2	–	–	–	–	–	–	–	–	–	32
1878	8	2	2	3	3	–	–	–	1	–	–	–	–	–	19
1879	6	8	3	1	3	–	1	1	–	–	–	–	–	–	23
1880	3	–	3	–	1	–	–	–	1	–	–	–	–	–	8
1881	3	5	6	3	8	–	1	–	2	–	–	–	–	–	28
1882	2	5	5	3	6	–	1	1	1	–	–	–	–	–	24
1883	3	7	5	1	3	–	–	–	–	–	–	–	–	–	19
1884	5	6	13	–	12	–	–	–	–	–	–	–	–	–	36
1885	4	7	8	2	4	2	–	–	1	–	–	–	–	–	28
1886	9	23	7	1	7	10	1	–	1	–	–	–	–	–	59
1887	10	17	8	1	9	8	1	1	3	–	–	–	–	–	58
1888	11	25	4	5	10	17	3	1	1	–	–	–	–	–	77
1889	14	24	5	3	8	17	1	1	2	–	–	–	–	–	75
1890	25	28	3	5	13	18	3	2	6	–	–	–	–	–	103
1891	18	26	4	6	11	23	3	3	1	7	–	1	–	–	103
1892	22	26	4	13	7	36	6	1	7	4	6	1	–	–	133
1893	25	30	5	2	8	41	2	–	6	8	–	2	–	–	129
1894	21	31	4	14	11	33	1	3	5	12	3	–	–	–	138
1895	25	30	3	15	14	33	–	2	4	11	4	–	5	–	144*
1896	26	34	10	24	17	48	3	3	7	7	4	3	5	–	190*
1897	25	40	7	16	20	33	2	3	7	12	4	1	9	–	179
1898	32	41	7	29	25	33	3	4	6	9	3	–	7	–	199
1899	30	37	9	22	22	32	2	2	1	10	1	–	8	–	173*
1900	32	34	21	21	19	23	3	3	5	11	4	–	9	–	185
1901	37	39	18	21	17	25	1	1	6	14	4	1	16	–	200
1902	24	46	14	18	14	35	5	3	3	9	7	–	14	–	192
1903	26	37	27	15	13	39	1	3	1	10	4	1	12	1	190
1904	34	45	32	24	15	34	3	5	5	7	2	1	17	8	232
1905	46	54	26	12	23	31	3	–	3	13	5	1	24	3	244
1906	47	69	38	22	21	37	2	4	–	10	6	–	19	3	278
1907	37	52	22	21	10	32	–	–	–	14	3	2	10	5	208
1908	48	61	19	19	16	38	4	–	–	15	2	–	5	2	229
1909	50	41	30	18	12	42	5	3	–	13	9	–	5	3	231
Totals	787	965	416	367	404	720	63	54	96*	196	71	14	165	25†	4,338*

Names counted twice, students graduating in two different years	20
Bachelors of Science	4,318*
Masters of Science, not included in the above	44
Doctors of Philosophy, not included in the above	3
Total	4,365*

* Deducting names counted twice (students graduating in two courses).

† Prior to 1909 this Course was designated as Option 3 (Electrochemistry) of Course VIII.

STATISTICS OF ADMISSION.

	Regular.	*Special.*	*Total.*
Admitted clear	129	0	129
" with one condition	66	1	67
" with two conditions	61	3	64
" with three conditions	24	1	25
" with four conditions	3	3	6
" on examination	283	8	291
Total First-year Class	318	55	373

ted but did not enter			57
dates at June Entrance Examinations			641
dates rejected in June	Complete candidates	19	
	Final "	20	
	Preliminary "	43	
	Partial "	29	
		111	
dates in September for Entrance and Advanced Standing Examinations			301
dates rejected in September	Complete candidates	9	
	Final "	9	
	Preliminary "	8	
cates of the College Entrance Examination Board submitted			85

TOTAL REGISTRATION AND NUMBER OF NEW STUDENTS.

AR.	(1) Total No. of Students.	(2) No. of Students in the Catalogue of the previous year who remain in the Institute.	(3) No. of New Students entering before issue of Catalogue.	(4) Of those in column (3) the following number are regular First year Students.	(5) No. of New Students not of the regular First year Class.
901	1,277	789	488	312	176
902	1,415	844	571	396	175
903	1,608	949	659	432	226
904	1,528	1,042	486	249	237
905	1,561	986	575	295	280
906	1,466	984	482	213	269
907	1,397	862	535	272	263
908	1,415	888	527	273	254
909	1,462	868	594	323	271
910	1,479	891	579	317	262

NEW STUDENTS FROM OTHER COLLEGES.

Class, by Year, Joined at Institute.	Years Spent at College.					Total
	One.	Two.	Three.	Four.	Five	
First	13	9	1	3	—	26
Second	12	20	5	25	1	63
Third	1	4	12	45	—	62
Fourth	—	2	2	12	1	17
Graduate	—	—	—	5	6	11
Total	26	35	20	89	8	179

GRADUATE STUDENTS.

Colleges and Universities Represented.

Albright	1	Massachusetts State Agricultural	1
American International	1	Middlebury	2
Amherst	3	Minnesota	1
Anatolia	1	Mississippi Agricultural	2
Arkansas	1	Missouri	1
Armour Institute	1	Nebraska	1
Austin	1	Newberry	1
Bates	2	New Brunswick	1
Beloit	2	New York University	2
Boston College	1	Notre Dame	1
Boston University	2	Oregon	2
Bowdoin	1	Pennsylvania Military	2
Brown	3	Pennsylvania State	2
Buenos Ayres National	1	Princeton	6
Carleton	1	Purdue	1
Central College	1	Queen's	2
Chicago	1	Radcliffe	2
City of New York	3	Rhode Island Agricultural	3
Coe	1	Rochester	6
Columbia	1	Sacred Heart	1
Cornell	3	Saint John	1
Dakota Wesleyan	2	Saint Louis	3
Dartmouth	10	Saint Xavier	1
DePauw	1	Smith	1
Ecole Polytechnic (Montreal)	1	South Carolina	1
Franklin and Marshall	2	South Dakota	1
Greece National	1	Texas Agricultural	2
Georgia School of Technology	1	Texas University	2
Georgia University	1	United States Naval Academy	14
Harvard	14	Virginia Military	3
Havana (Cuba)	1	Virginia Polytechnic	1
Holy Cross	2	Washington and Jefferson	2
Illinois	1	Washington and Lee	3
Japanese Naval Engineering	1	Wesleyan	3
Johns Hopkins	2	Western Reserve	1
Kansas	1	Whitman	1
Kansas State	1	Williams	6
Lafayette	1	William and Mary	1
Lehigh	1	Wooster	1
Leland Stanford Junior	2	Yale	17
McGill	3		203
Marietta	1	Counted twice	3
Maryland Agricultural	1		200
Massachusetts Institute of Technology	15		

Graduates who are candidates for Advanced Degrees	13
Graduates who are pursuing undergraduate work	187
Colleges and Universities represented	84

COURSES OF INSTRUCTION.

ULAR AND SPECIAL STUDENTS BY COURSES FOR THE CURRENT YEAR.

Civil Engineering.	Mechanical Engineering.	Mining Engineering and Metallurgy.	Architecture.	Chemistry.	Electrical Engineering.	Biology.	Physics.	General Science.	Chemical Engineering.	Sanitary Engineering.	Geology.	Naval Architecture.	Electro-chemistry.	Total.
52	49	22	13	7	37	3	—	2	16	12	—	8	3	224
14	16	9	21	9	24	2	—	1	6	4	1	7	2	116
39	37	14	9	8	43	—	2	1	19	12	—	8	1	191*
28	18	12	19	11	27	5	—	—	5	11	—	6	3	144*
43	48	20	11	3	50	5	2	—	29	16	—	4	1	228
28	34	22	31	5	18	4	—	—	9	4	—	8	4	167
135	134	55	33	18	131	8	4	3	64	41	—	20	4	643*
70	69	44	71	25	69	11	—	1	20	19	1	21	10	427*
205	203	99	104	43	200	19	4	4	84	60	1	41	14	1,073*

THE SAME CLASSIFICATION FOR FOUR YEARS.

Civil Engineering.	Mechanical Engineering.	Mining Engineering.	Architecture.	Chemistry.	Electrical Engineering.	Biology.	Physics.	General Science.	Chemical Engineering.	Sanitary Engineering	Geology.	Naval Architecture.	Naval Construction.	Electro-chemistry.
210	214	100	94	49	192	10	18	0	55	32	2	43	17	—
210	226	118	82	53	200	17	20	2	59	39	0	37	16	—
195	196	102	85	58	206	20	19	4	71	52	2	41	13	—
205	203	99	104	43	200	19	4	4	84	60	1	41	—	14

ER OF STUDENTS PURSUING CERTAIN LEADING BRANCHES OF STUDY.

	First Year.	Second Year.	Third Year.	Fourth Year.	Total.
istry	375	135	118	96	724
l	350	367	38	—	755
. . . . .	154	35	17	—	206
y	—	49	103	30	182
n	148	60	23	—	231
natics	416	356	136	—	908
nics Arts	—	124	49	125	298
. . . . .	—	355	326	38	719

*Deducting names counted twice.

REGULAR FIVE-YEAR STUDENTS.

YEAR.	Total.	Civil Engineering.	Mechanical Engineering.	Mining Engineering.	Architecture.	Chemistry.	Electrical Engineering.	Biology.	Physics.	General Science.	Chemical Engineering.	Sanitary Engineering.	Geology.	Naval Architecture.
1st	9	–	–	–	–	–	–	–	–	–	–	–	–	–
2d	10*	–	6	2	–	–	3	1	–	–	1	–	–	1
3d	17*	1	3	3	3	3	2	–	–	–	–	2	–	1
4th . . .	10	–	4	–	–	–	1	–	–	2	–	3	–	–
5th . . .	5	1	2	–	–	–	1	1	–	–	–	–	–	–
	51*	2	15	5	3	3	7	2	–	2	1	5	–	2

WOMEN STUDENTS.

COURSE.	Architecture.		Chemistry.		Biology.		Total
Year of Course.	Regular.	Special.	Regular.	Special.	Regular.	Special.	
Graduate	–	–	–	–	–	–	–
Fourth	–	–	1	–	–	–	1
Third	1	1	–	–	–	1	3
Second	–	1	–	1	–	–	2
Special, without course classifications . . .	–	–	–	–	–	–	2
Totals	1	2	1	1	–	1	8

STATISTICS OF GRADUATION, CLASS OF 1909.

Number receiving degree at end of one year	5
" " " " " " two years	35
" " " " " " three "	26
" " " " " " four "	103
" " " " " " five "	60
" " " " " " six "	4
Total number of degrees of S. B. awarded	233*
Number entering from other colleges	81
" graduates	55
" non-graduates	26

* Including one recommended since June, and one as of the Class of 1908.

RTHER STATISTICS OF THE STUDENTS FROM OTHER COLLEGES OF THE GRADUATING CLASS, JUNE, 1909.

rs. at the Inst.	Graduate.	Non-graduate.	Total.
1	5	–	5
2	33	2	35
3	13	13	26
4	4	8	12
5	–	3	3
	55	26	81

ES OF THE MEMBERS OF THE GRADUATING CLASS, JUNE, 1909.

Under 20½	1
Between 20½ and 21	3
" 21 " 21½	17
" 21½ " 22	29
" 22 " 23	58
" 23 " 24	55
" 24 " 25	29
" 25 " 26	21
26 and over	20
Total	233*

he average age was 23 years.

AGES OF THE REGULAR FIRST-YEAR STUDENTS.

Period of Life.	1908–1909.		1909–1910.	
	Half-year Groups.	Yearly Groups.	Half-year Groups.	Yearly Groups.
16½ years	—	—	—	—
to 17 "	3	3	4	4
17½ "	11	—	17	—
to 18 "	20	31	20	37
18½ "	50	—	53	—
to 19 "	64	114	70	123
19½ "	69	—	49	—
to 20 "	31	100	31	80
20½ "	30	—	16	—
to 21 "	11	41	16	32
22 "	11	11	16	16
	300	300	292	292

Repeating the first year	4
Students of unusual age	22
Average age, omitting these 26	19 years

* Including one recommended since June.

SUMMER SCHOOL.

	1908.	1909.
Number from other colleges and schools attending	52	44
Number not referring to any other college or school	3	5
Number from Massachusetts Institute of Technology	214	166
	269	215
Number who registered, but did not attend	7	9
Number who applied, but cancelled registration	6	1
Registrations for failures or deficiencies	184	140
Registrations to anticipate work	312	266

NUMBER OF STUDENTS REGISTERED IN EACH OF THE COURSES OF THE SUMMER SCHOOL FOR THIS YEAR AND THE YEAR BEFORE.

	1908.	1909.
Applied Mechanics	48	19
Carpentry	7	7
Chemistry, Inorganic and Analytical	46	37
Chipping and Filing	4	3
Descriptive Geometry	34	34
Design	14	7
English	0	6
Field Geology	0	1
Forging	9	7
French	4	6
German	5	6
Integral Calculus	22	0
Machine Tool Work	16	29
Mathematics (1)	19	17
Mathematics (2)	0	12
Mechanical Drawing	14	20
Mechanical Engineering Drawing	21	15
Mechanism	21	9
Metal Turning	5	0
Organic Chemical Laboratory	8	7
Pattern Work 122–123	8	8
Physical Laboratory	8	5

RESIDENCE OF STUDENTS.

:BER OF STUDENTS IN EACH YEAR, FROM 1902, COMING FROM EACH STATE OR TERRITORY.

AND TERRITORIES	1902.	1903.	1904.	1905.	1906.	1907.	1908.	1909.
North Atlantic.								
icut	43	44	48	50	36	29	31	32
	35	34	26	22	18	23	22	20
husetts	935	869	889	807	764	781	839	852
mpshire	34	23	36	32	26	27	24	27
rsey	8	13	16	11	15	17	14	14
rk	96	104	94	71	84	82	99	99
vania	44	52	56	58	55	57	53	46
Island	40	28	19	24	23	28	28	30
t	12	11	5	5	4	5	6	6
tal	1,247	1,178	1,189	1,080	1,025	1,049	1,116	1,126
South Atlantic.								
re	4	3	2	1	2	1	—	1
Columbia	17	15	7	13	12	10	10	8
	2	2	4	3	3	3	6	5
	6	4	6	8	4	2	3	4
nd	27	25	18	19	17	8		12
Carolina	6	7	1	—	1	—	1	—
Carolina	4	—	—	1	3	2	—	2
a	7	7	4	7	8	9	11	10
irginia	—	—	—	1	2	3	3	2
tal	73	63	52	53	52	48	51	44
South Central.								
ıa	1	1	1	1	2	4	3	5
as	1	1	—	1	—	2	1	2
ky	11	9	8	5	5	5	4	4
na	2	3	5	1	2	—	3	2
ippi		4	4	4	5	3	3	3
see	5	5	2	2	3	6	8	8
	9	11	13	16	15	16	16	13
tal	27	33	33	30	32	36	38	37
North Central.								
	49	44	43	42	37	31	23	24
a	14	6	10	10	15	12	9	11
	8	6	9	13	14	16	14	5
s	1	1	4	7	6	5	4	6
an	10	9	9	10	7	8	7	10
sota	10	9	11	13	14	8	8	10
ri	20	22	25	29	17	14	6	7
ka	5	4	5	4	2	3	2	4
Dakota	1	1	1	—	3	4	3	3
	43	37	35	34	30	26	30	27
Dakota	1	3	2	—	1	3	3	5
sin	11	13	14	12	7	12	12	11
otal	173	155	168	174	153	142	121	123
Western.								
nia	15	19	18	23	21	14	20	25
do	10	11	16	17	12	10	5	6
	—	—	—	—	—	—	1	—
na	3	2	5	3	3	3	2	3
a	—	—	—	1	1	1	1	—
lexico	1	1	2	—	—	1	1	1
oma	—	—	—	—	—	1	1	—
n	4	7	8	5	2	3	4	7
	2	3	3	2	3	3	5	5
ngton	3	3	2	2	5	12	13	11
ing	1	—	—	2	5	1	1	1
otal	39	46	54	55	52	49	54	59

District.	1902.	1903.	1904.	1905.	1906.	1907.	1908.	1909.
Canal Zone	–	–	–	–	–	–	1	1
Hawaii	–	1	1	1	2	2	1	2
Philippine Islands	–	–	4	2	3	1	1	1
Porto Rico	2	2	4	5	2	3	6	7
Total	2	3	9	8	7	6	9	11
Total for the United States	1,561	1,478	1,505	1,400	1,321	1,330	1,389	1,400

Number of Students in Each Year, from 1902, coming from Each Foreign Country.

Foreign Countries.	1902.	1903.	1904.	1905.	1906.	1907.	1908.	1909.
Alberta	–	–	–	–	–	–	–	1
Argentine Republic	–	–	–	–	1	2	2	4
Armenia	–	1	1	3	2	2	2	–
Australia	2	3	1	3	3	3	–	–
Austria	–	–	–	–	–	–	–	–
Belgium	–	–	–	–	1	1	–	–
Bermuda	1	1	–	1	1	–	–	–
Brazil	5	3	3	1	–	2	3	1
British Columbia	–	–	–	–	1	–	1	2
Bulgaria	–	–	–	–	–	–	–	1
Cape Breton	–	–	–	–	–	–	1	1
Cape Colony	–	–	–	–	1	1	1	–
Central America	–	–	1	–	–	–	1	–
Chile	1	1	1	2	1	1	1	1
China	1	2	8	8	7	9	10	11
Costa Rica	–	–	–	–	–	2	3	2
Cuba	2	3	4	4	4	4	2	7
Denmark	1	1	1	1	1	1	–	–
Ecuador	–	–	1	–	2	2	2	1
Egypt	–	–	–	1	2	2	2	1
England	3	4	4	5	6	4	3	–
France	–	–	1	1	–	–	–	–
Germany	1	2	–	–	–	–	–	1
Honduras	–	–	–	–	1	–	1	3
India	–	1	1	2	1	1	2	1
Ireland	1	1	–	2	2	3	1	–
Italy	–	–	–	2	–	2	1	1
Jamaica	–	–	1	–	1	–	1	1
Japan	1	2	1	3	5	3	4	4
Korea	–	–	2	–	–	–	–	–
Malta, Island of	–	1	1	–	–	–	–	–
Manitoba	1	1	–	–	–	–	–	–
Mexico	10	8	4	7	12	12	6	10
New Brunswick	2	1	2	4	3	2	1	3
New Zealand	–	–	–	–	–	–	–	1
Nova Scotia	8	9	4	1	4	3	4	5
Ontario	2	2	5	6	6	4	7	6
Panama	–	–	–	–	–	1	–	–
Paraguay	–	–	–	–	–	1	1	1
Peru	–	–	–	1	1	2	2	1
Poland	–	–	–	–	–	1	–	–
Quebec	–	1	2	1	1	–	1	2
Russia	–	–	–	–	–	2	2	2
Scotland	1	1	2	1	1	1	–	–
Sweden	–	–	1	–	–	–	–	–
Switzerland	–	–	–	–	–	–	–	1
Syria	–	1	1	–	–	–	–	–
Transvaal	–	–	1	3	3	3	2	–
Turkey	4	–	2	1	1	2	1	2
Uruguay	–	–	–	2	1	1	1	–
Total	47	50	56	66	76	80	72	79
Total in school	1,608	1,528	1,561	1,466	1,397	1,410	1,461	1,479

IDENCE OF STUDENTS FOR THIS SCHOOL YEAR.

	Candidates for Advanced Degrees.	Fourth Year.	Third Year.	Second Year.	First Year.	All Regular Students.	Special Students.	Total.
. .	—	1	1	—	—	2	3	5
. .	—	—	—	1	—	1	1	2
. .	1	4	3	3	1	12	13	25
. .	—	—	1	—	—	1	—	1
. .	—	1	1	—	1	3	3	6
. .	1	7	1	10	8	27	5	32
. .	—	—	—	—	1	1	—	1
ibia	—	—	2	2	1	5	3	8
. .	1	—	—	1	—	2	3	5
. .	—	—	2	—	—	2	2	4
. .	—	—	—	—	1	1	1	2
. .	—	3	3	3	1	10	14	24
. .	2	1	2	2	1	8	3	11
. .	1	1	—	1	—	3	2	5
. .	1	—	—	1	1	3	3	6
. .	—	—	1	1	—	2	2	4
. .	—	2	—	—	—	2	—	2
. .	—	3	6	2	2	13	7	20
. .	—	4	4	2	—	10	2	12
s .	12	124	108	141	230	615	237	852
. .	—	2	2	2	2	8	2	10
. .	—	2	—	—	—	2	8	10
. .	—	—	—	—	1	1	2	3
. .	1	—	1	1	—	3	4	7
. .	—	1	1	—	—	2	1	3
. .	—	—	—	1	1	2	2	4
ire .	—	8	1	4	6	19	8	27
. .	—	—	—	5	3	8	6	14
. .	—	—	1	—	—	1	—	1
. .	3	16	16	13	16	64	35	99
a . .	—	—	1	1	—	2	1	3
. .	—	5	2	7	3	17	10	27
. .	—	1	—	—	—	1	6	7
. .	1	12	4	4	8	29	17	46
ands	—	—	—	1	—	1	—	1
. .	—	—	1	3	2	6	1	7
. .	2	3	6	1	5	17	13	30
ia .	—	—	1	—	—	1	1	2
t . .	—	2	—	1	—	3	2	5
. .	1	3	—	1	1	6	2	8
. .	1	3	2	1	1	8	5	13
. .	—	—	—	1	—	1	4	5
. .	—	1	—	1	—	2	4	6

States.	Candidates for Advanced Degrees.	Fourth Year.	Third Year.	Second Year.	First Year.	All Regular Students.	Special Students.	Total.
Virginia . . .	—	2	2	1	1	6	4	10
Washington . .	—	4	1	—	1	6	5	11
West Virginia .	—	—	—	—	1	1	1	2
Wisconsin . .	—	3	3	1	1	8	3	11
Wyoming . . .	—	—	1	—	—	1	—	
Total . . .	28	217	183	220	301	949	451	1,400
Foreign Countries.								
Alberta	—	—	—	—	—	—	1	1
Argentina . .	—	1	2	—	—	3	1	4
Brazil	—	—	—	—	1	1	—	1
BritishColumbia	—	—	—	—	—	—	2	2
Bulgaria . . .	—	—	—	—	—	—	1	1
Cape Breton .	—	—	1	—	—	1	—	1
Chile	—	—	—	—	—	—	1	1
China	—	1	—	3	1	5	6	11
Costa Rica . .	—	—	—	1	—	1	1	2
Cuba	1	1	—	—	4	6	1	7
Ecuador . . .	—	1	—	—	—	1	—	1
Egypt	—	—	—	—	—	—	1	1
Germany . . .	—	—	1	—	—	1	—	1
Honduras . . .	—	—	—	2	—	2	1	3
India	—	—	—	—	—	—	1	1
Italy	—	—	—	—	1	1	—	1
Jamaica . . .	—	—	—	1	—	1	—	1
Japan	—	1	—	—	—	1	3	4
Mexico	—	1	1	—	5	7	3	10
New Brunswick	1	—	—	—	1	2	1	3
New Zealand .	—	—	—	—	—	—	1	1
Nova Scotia .	1	1	—	1	—	3	2	5
Ontario . . .	1	—	1	—	1	3	3	6
Paraguay . . .	—	—	—	—	—	—	1	1
Peru	—	—	—	—	—	—	1	1
Quebec	1	—	—	—	—	1	1	2
Russia	—	—	1	—	1	2	—	2
Switzerland . .	—	—	—	—	1	1	—	1
Transvaal . .	—	—	—	—	—	—	1	1
Turkey	—	1	—	—	1	2	—	2
Total . . .	5	7	8	8	17	45	34	79

RESIDENCE OF MASSACHUSETTS STUDENTS.

County.	No. of Towns.	No. of Students.	County.	No. of Towns.	No. of Students
able	2	7	Middlesex	29	249
ire	6	10	Nantucket . . .	1	2
. . . . .	8	23	Norfolk	20	101
. . . . .	2	4	Plymouth	14	35
. . . . .	21	107	Suffolk	4	256
in	5	6	Worcester	15	25
den	5	24	Total	135	852
shire	3	3			

FROM CITIES WHICH SEND FIVE OR MORE STUDENTS.

Boston	235	Springfield	12	Natick	7
Newton	48	Winchester	11	Revere	7
Brookline	32	Lynn	10	Wakefield	7
Cambridge	28	Salem	10	Barnstable	6
Somerville	27	Taunton	10	Concord	6
Malden	18	Chelsea	9	Canton	5
Lowell	17	Framingham	9	Danvers	5
Newburyport	17	Hyde Park	9	Fitchburg	5
Lawrence	16	Melrose	9	Haverhill	5
Waltham	15	Beverly	8	Marlboro	5
Quincy	13	Holyoke	8	Medford	5
Brockton	12	Weymouth	8	Winthrop	5
Everett	12	Gloucester	7		

DISTRIBUTION OF MASSACHUSETTS STUDENTS, ABOVE THE FIRST YEAR, AMONG THE COURSES.

YEAR.		Civil Engineering.	Mechanical Engineering.	Mining Engineering and Metallurgy.	Architecture.	Chemistry.	Electrical Engineering.	Biology.	Physics.	General Science.	Chemical Engineering.	Sanitary Engineering.	Geology.	Naval Architecture.	Electrochemistry.	Total.	
4th Year	Reg.	28	27	16	5	6	19	3	–	1	7	7	–	2	3	124	
	Sp.	6	7	3	9	7	13	–	–	–	3	2	–	1	2	53	
3d Year	Reg.	24	19	4	5	6	25	–	1	–	14	9	–	1	–	108	
	Sp.	14	8	7	5	6	9	4	–	–	2	11	–	1	2	68*	
2d Year	Reg.	26	27	12	8	2	28	5	1	–	21	12	–	–	–	141*	
	Sp.	18	19	12	16	2	8	4	–	–	4	2	–	5	2	92	
1st Year	Reg.	–	–	–	–	–	–	–	–	–	–	–	–	–	–	230	
	Sp.	–	–	–	–	–	–	–	–	–	–	–	–	–	–	24	
Total	Reg.	78	73	32	18	14	72	8	2	1	42	28	–	3	3	373*	840 Adv.
	Sp.	38	34	22	30	15	30	8	–	–	9	15	–	7	6	213*	12 Deg.
Totals		116	107	54	48	29	102	16	2	1	51	43	–	10	9	586*	852*

WALTER HUMPHREYS,

Registrar.

* Deducting names counted twice.

Reports of Departments.

PARTMENT OF CIVIL AND SANITARY ENGINEERING.

The most important occurrence in the Department during past year was Professor Swain's resignation. The high aracter of his work at the Institute and his ability as a cher and an engineer are so widely recognized, that ended mention of them here seems superfluous. It is ›ropriate, however, to express in behalf of the Instructing ıff of the Department its appreciation of the service ren- ed by him to the Institute and to the Civil Engineering ›fession at large in the promotion of high teaching ideals l sound engineering practice; and it is a matter for grati- ıtion that he will still remain near by as a counsellor l friend.

Another resignation greatly regretted by colleagues and dents was that of Associate Professor Mott, who in Au- ;t accepted an appointment as Professor of Civil Engineer- Practice at the Carnegie Technical Schools, Pittsburg. ›fessor Mott, of the Class of '89, became, not long after .duation, an Instructor at Cornell University, teaching ng the lines of Mechanics and Hydraulics. He returned the Institute in 1905 and immediately won a high posi- n in the respect and affection of students and fellow- chers, all of whom wish him the best of success in his new ties.

It is interesting to note that the position which Professor ain has been called to fill, and that which Professor Mott's ignation has created, constitute the first and the last ks of a chain of important teaching positions filled within ; year, and that five of those appointed to these positions ve been Institute graduates.

Associate Professor Arthur G. Robbins has been advanced to the grade of Professor of Topographical Engineering. He has taught continuously and successfully in the Department since his graduation in 1886.

New appointments are those of Charles M. Spofford to the chair of Hayward Professor of Civil Engineering made vacant by Professor Swain's resignation, and of Harold K. Barrows as Associate Professor of Hydraulic Engineering, the position held by Professor Mott.

Professor Spofford is a graduate of the Class of '93, taking advanced work during the following year. After a short experience in Railroad Engineering, he entered the service of the Phœnix Bridge Company, with whom, during a service of two years and several additional summers, he gained a very valuable practical experience, supplemented by work in designing structures for the city of Boston, the Boston Elevated Railway, and others. From 1896 to 1905, he taught Structures and Bridge Design at the Institute, in this way becoming thoroughly familiar with our work in these subjects. For four years he was head of the department of Civil Engineering at the Brooklyn Polytechnic Institute, which gave him an opportunity of exercising initiative in his teaching work along several lines, as well as of coming into touch with some important engineering projects, notably the Queensboro Bridge in New York. He returns to the Institute with a ripe and varied experience both in teaching and in practice, and the work under his care, both undergraduate and advanced structural work, is progressing most satisfactorily, and fully justifies the wisdom of his choice.

Harold K. Barrows, of the Class of '95, served for a year after graduation as an Assistant in the Department. After several years of practice in general lines of civil engineering, including work with the city of Newton, and with the Metropolitan Water Board in office design, he became Assistant Professor and afterwards Associate Professor of Civil Engineering at the University of Vermont. He left this posi-

ı to enter the United States Government Service as Engi-
:r and as District Hydrographer, positions which he has
d to the present. He has also established, and is now
rying on, a general practice, mainly in hydraulic engineer-
. His work in these connections has not only yielded him
unusual experience in hydraulic lines, but has given him
ɔortunity for valuable acquaintance among hydraulic
n. His appointment, just made at the time of writing
s report, gives assurance that the hydraulic work will
continued at a high standard of excellence.

Professor Russell, at the close of the summer vacation,
d completed the manuscript of his book on Hydraulics
ıich was published in October, and is now in use with all
ɜ classes taking this subject. It well fills a long felt need
· a text-book upon a subject, in which the fundamental
ıciples of hydraulics should be logically developed and
ɜir application clearly illustrated. While published and
apted for general use it has, nevertheless, been framed with
l appreciation of Institute needs and kept free from the
traneous matter often found in books on hydraulics.

The work in Hydraulic Measurements (steam gaugings)
s been carried on this fall by Professors Porter and Russell,
th the aid of Mr. Richard L. Cary, Assistant. By the
urtesy of the Proprietor of Locks and Canals, the tube and
spended meter gaugings have been made, as for years
st, in the Merrimack and Boott measuring flumes at Low-
, which are especially well suited to the purpose. In 1908,
d again this year, the gauging station on the Charles River
Newton Upper Falls, heretofore used for rod meters,
ıs found unsuitable because of the low stage of river and
e obstructed condition of the channel. Resort was there-
re had to Mother Brook, a cross-cut from the Charles to
e Neponset in the town of Dedham, carrying about one-
ılf as much water as the Charles at their junction, but an-
ɜering sufficiently well for student's work.

The time required from any one student for this course

is moderate, but because of the large number of students (over 70 this fall), the necessity of small field parties for proper instruction, and the limited number of afternoons available, it has become extremely difficult to complete the field work in the period of the term allotted to it. Each field trip requires from four to six hours of the instructors' time, resulting in a large aggregate for the season, because of the repeated trips with the different parties. The establishment of a summer school in surveying would permit this work also to be there given, with economy of time for students and instructors alike, and with simplification of the regular schedule of studies of the fall term.

For the class-room the Notes on Hydraulic Measurements have been revised by Professor Porter, and published for the use of our students.

As Assistants to fill the places of six who had resigned at the end of the year, there were appointed Richard L. Cary, Walter W. Clifford, Frederic R. Faulkner, Frank S. Lovewell, Morse W. Rew, and Arthur L. Shaw. All of these are graduates in the Class of '09, and four of them also hold degrees from other institutions.

Many of the Instructing Staff have been engaged upon professional work during the summer: among the number may be mentioned Professors Breed, Hosmer, and Moore; also Mr. Howard and Mr. Bradbury.

The library of Civil Engineering books has grown during Professor Swain's administration from one or two cases of books to a large and very complete library. As far as I know, it has no superior as a working library of Civil Engineering in this country, and its growth, together with that of the library of Mechanical Engineering, which together constitute the Engineering Library, rendered enlargement of the room absolutely necessary. This has been accomplished by extending the library, part of the space required being taken from the room used as a museum for the Department; while two of the offices have also been reduced

ze and rearranged, so that no encroachment has been
ssary upon the space utilized for students' use.
ith the demand for advanced work in Structures, Hy-
lics, and Sanitary Engineering which seems now defi-
y established, there is needed a room which can be used
as a lecture and a drafting room for advanced students
. The present accommodations for such students is
equate. The present fourth-year drafting room is no
than adequate for the regular undergraduate class,
the same is also true of the second and third year rooms.
ne most urgent need in the Department is a site and build-
for a Summer School of Surveying. This may properly
considered the Laboratory of Civil Engineering. The
work of general or of railroad surveying cannot be sat-
torily carried on from a large city as a base, as we now
mpt to do it. More than half the time assigned is wasted
ravel and in getting under way, and satisfactory results
substantially out of the question in the limited time
lable during one exercise. The present system is not
wasteful in time, but also unproductive in results.
le improvements or extensions in many lines of Insti-
work must be delayed until the question of site for the
itute is settled, provision for the Summer School of
veying can be made entirely independent of that consider-
n, and I cannot too strongly urge its necessity. Profes-
Swain has very fully presented the matter in the last and
previous reports, and not only is the Department unani-
isly and strongly in favor of it, but finally it has received
endorsement of the Faculty after careful consideration
a special committee.
pon Professor Swain's retirement as head of the Depart-
nt, a change was made in the organization of the work
viously done by him, by which his administrative duties
e been divided. Professor Spofford represents the Course
Civil and Topographical Engineering in connection with
ulty or students; and Professor Porter in similar fash-

ion represents the Course in Sanitary Engineering. The Department of Civil and Sanitary Engineering in its general and administrative work is represented by Professor Allen. In addition to this division of duties, more control and initiative is expected to be exercised by Professors Porter, Robbins, Spofford and Allen in the lines of Hydraulics, Surveying, Structures, and Railroads, respectively. This arrangement is more democratic and seems to be thus far effective and satisfactory in its workings, while it appears to meet with general favor among the members of the Department.

As for some years past, two important lectures were delivered near the close of the school year by Mr. Henry E. Warren, Superintendent of the Lombard Governor Company, on the Governing of Turbines. The lectures were given jointly to the students in the Courses in Civil, Mechanical and Sanitary Engineering.

Gifts have been received for exhibition purposes from Mr. A. Guerin, Middleboro, Mass., and from George N. Newhall Engineering Company, Philadelphia. Special courtesies have also been extended to the Department by the Boston & Maine Railroad through Mr. Henry C. Robinson, Superintendent of the Southern Division, and the Department is indebted to the same railroad for special rates granted to our students for their trips to Lowell on Hydraulic Field Work.

C. FRANK ALLEN.

THE COURSE IN CIVIL ENGINEERING.

There have been no important changes in the curriculum during the past year. This year, however, it becomes possible for the first time to observe the full effect of the change made in the course of studies in 1906 by the reduction of the time allotted to modern languages. The present senior class is the first to enter since this change was made and

ows, I believe, a decided gain in professional efficiency as mpared with classes reaching the fourth year without ceiving the advantage of the extra training in fundamental ofessional subjects made possible by this change. In nnection with this topic it may be interesting to note at of the students in this class twelve per cent. studied a odern language as an elective in the third year, and thirty-ur per cent. took more modern language than is required our own Course, at other schools or colleges before enter-g the Institute.

On returning after four years' absence, I am more than er impressed by the increasing difficulty of giving proper struction in surveying and railroad field-work during the llege year. The disadvantages of the present arrange-ent were so plainly stated by Professor Swain in his last nual report that enumeration of them here is unnecessary. wish, however, to express my strong belief in the wisdom giving these courses hereafter in a summer camp in ac-rdance with the plan already sanctioned by the Faculty. his change I consider to be essential to the proper teaching these subjects and to the future development and strength-ning of the entire course.

The number of students from other colleges registered in ivil Engineering this year continues large. Of sixty-six udents in the senior class, thirty-five per cent. entered from her colleges, and twenty-six per cent. are holders of the achelor's degree. Out of a total registration of two hun-red and ten in the three upper classes, twenty-eight per nt. entered the Institute from other institutions. Ad-nced courses are now being given to a number of students nongst whom is one candidate for the degree of Master of cience in Civil Engineering. The importance of advanced ork of the character given at the Institute is becoming ore widely recognized by men wishing to specialize in rtain branches of Civil Engineering, and it is intended to nphasize such work more fully hereafter.

With the completion of Professor Russell's book on Hydraulics, books prepared by our own professors are now available for instruction in three of the four fundamental civil engineering subjects. The subjects thus included are Surveying, Railroad Curves and Earthwork, and Hydraulics. The fourth basic subject, Structures, is given this year from mimeographed notes prepared by myself which will eventually be put into book form. The advantage of having these four fundamental subjects taught from texts prepared by our own staff and in complete harmony with the system of instruction in the Department is believed to be considerable.

The demand for our graduates continues active. Statistics showing the total number of applications during the year are not at hand, but since September 1st requests have been received for twenty-five men. Some of these applications have been for men to fill important positions for which it has been possible to recommend men already holding good positions. Most of them, however, have been for recent graduates and in only one or two instances has it been possible to fill these, owing to lack of available men.

CHARLES M. SPOFFORD.

THE COURSE IN SANITARY ENGINEERING.

Within the past two or three years there has been a noticeable increase in the number of students electing the Course in Sanitary Engineering. Differentiated from the Civil Engineering Course some twenty years ago by the introduction of Biology and somewhat advanced chemical work, with a corresponding curtailment of railroad, structural and some other studies, it has usually furnished from three to six students for graduation. This year there were nine, and at present there are altogether about fifty students in the

e higher years. A majority of the graduates have gone sanitary engineering work, and some have achieved ked success.

xperience having indicated that the curriculum of this rse might be changed to advantage, a committee of seven appointed by the Faculty last spring to consider the ter. The committee solicited and received valuable estions from several prominent alumni of the Institute ged in sanitary engineering practice in New York and where, and was especially favored by having the co-ation of Messrs. Leonard Metcalf, William S. Johnson, Robert Spurr Weston, of this city. As a result of its y the committee has recommended to the Faculty a very iderable increase in the time devoted to chemistry in second and third years, and a resulting reduction in the ber of distinct studies undertaken in the latter of these. change, last referred to, will largely remedy the extreme sion of the student's time among many subjects, which hitherto been required; and with the grouping of the ents of this Course into distinct sections whenever ticable, to the peculiar needs of which their instruction then be confined, it is fair to expect a decided improve-t in the results accomplished, and therefore in the use-ess and attractiveness of the Course.

dvanced instruction in Sanitary Engineering has been ed this year by four graduate students, one of them our own class of '08, and one each from Armour In-te of Technology, University of Minnesota, and Purdue versity.

DWIGHT PORTER.

DEPARTMENTS OF MECHANICAL ENGINEERING AND APPLIED MECHANICS.

In the report of last year reference was made to the fact that, notwithstanding the period of business depression existing in June 1908, all the graduates in Mechanical Engineering of that year had found employment by the middle of October. The graduates in Mechanical Engineering of June 1909 have had better opportunities, the number of applications for men having been double the number available.

The 500 K. W. Westinghouse Parsons Steam Turbine which was installed last year was provided with a hydraulic brake, but during the past summer a 60 cycle 2,300 bolt generator has been substituted for the brake thus enabling us to conform in its operation more nearly to the conditions of practice. If one or two motor generator sets were to be added, which would enable us to transform the alternate into a direct current, this turbine would be able to supply all the power needed in the buildings of the Institute which are situated on Boylston, Clarendon Streets, and Trinity Place. A considerable saving could thus be effected, as at present the power has to be used up in heating the water of a water rheostat.

A considerable amount of original work has as usual been performed in the laboratories of the Department, and of the twenty-seven theses performed by the forty-six members of the graduating class in Mechanical Engineering, ten were performed in order to solve some industrial problem that had arisen in the business of some firm which, in the greater part of these cases, furnished, at its own expense, most of the material used, or provided facilities and set up apparatus for making the tests. Six had for their object the solution of some industrial problem of general interest in engineering, while the purpose of eight was to

upon some stage of an investigation which, when com-
l, would serve to solve industrial problems. Of the
class may be mentioned:—

Lift and discharge of safety valves, regarding which
is considerable difference of opinion among manu-
rers.

Tests of certain reinforced concrete beams of unusual
n to furnish evidence regarding the proper method of
portioning some important constructions of the present

Test of a 750 K. W. Allis Chalmers Parsons Steam
bine the results of which were of importance to the firm
g the turbine.

Service test of the turbine steamer "Harvard" for
er speed and economy.

The behavior of locomotive driving springs under
ated stress, this being one phase of an investigation of
motive springs, for the prosecution of which materials
facilities have been furnished by three firms.

f the second class may be mentioned:—

Investigation of the effect of water vapor in the ex-
ive mixture of an oil engine.

Investigation of the ideal marine engine for horse-
er and full consumption at various speeds.

he following gifts and loans have been made to the
partment:—

. gift of a pulsometer pump, 3 inch discharge, by the
erson Steam Pump Company; a gift of a three ton Har-
gton Hoist, presented by the makers; both of which
e obtained through the kindness of Mr. Harold L. Bond,
o has also informed me that a centrifugal pump will be
sented by the Lawrence Pump and Engine Company.
. Alfred W. French, '89 is now constructing an hydraulic
umulator as a present to the Department. Very com-
te sets of blueprints of the details of four power stations
the West End Road have been presented by Mr. Paul

Winsor, '86, and by Messrs. Stone and Webster, '88. A complete set of blueprints of a re-enforced concrete factory building has been presented by Mr. J. R. Worcester. A vertical simple engine has been loaned by the B. F. Sturtevant Company, and a twelve horse-power Gray gasolene engine has been loaned by the makers.

The most pressing needs of the Department are:—

A refrigerating plant; an impact testing machine; a gas producer plant; a large blower and auxiliary apparatus to enable us to carry on experiments on a larger scale than heretofore upon the lift and drift of various surfaces for aëronautic purposes; a stationary plant for testing locomotives; a modern electric blueprint apparatus, as what little we now have can only be used in sunlight, is worn out, and is entirely inadequate for the needs of the Department.

More room is also needed to relieve present crowding; to furnish room for students to carry on thesis work upon apparatus brought in from outside; and to provide storage room for large and miscellaneous apparatus to be used on thesis work conducted outside. Room is also needed for stripping machines for the purpose of Machine Drawing, and for making and storing re-enforced concrete beams, columns, etc., for testing purposes.

Another need of the Department which was explained in detail in the report of January 1908 is to have certain special assistants of the grade of instructor, whose duties should be confined to the carrying on of prolonged investigation, to the preparing for publication of their results, and also of those of the many investigations that have already been made in the Laboratory. Also it would be necessary to provide some channel where these results would be regularly published.

Instructor Royal R. Heuter has been granted a leave of absence for two years and is studying in Germany.

GAETANO LANZA.

DEPARTMENT OF MINING ENGINEERING AND METALLURGY.

'eed of Space.—This has been very pressing. A little porary relief has been gained by transferring some of less used books from the library up into the old "cage" Rogers Building. This transfer means that these books not so readily accessible. A hole has been cut through gain access under Room 7. This allows us to store away s and fluxes which formerly had to be kept up on the floors. e cutting of this hole necessitated the temporary disuse he roasting kiln in the metallurgical department and also rearrangement of some of the smaller furnaces. The ts of the kiln have been stored however so it can quickly restored if needed.

Vew Apparatus.—In the line of new equipment we have led four new assay button balances, which replace an ıal number of old ones, a much needed improvement. sides these we have put in several new pouring tables and ew and improved type of bottle agitator. A cast iron tap- ıg spout has been installed on the reverberatory furnace to used in the copper refining run. With its use we are able to) and cast the copper very easily. In former times this op- .tion was unsatisfactory and at times somewhat dangerous. ıe screw feeder for the trommel has been remodelled so ıt no trouble is had in its working. A new hand jig, 12 hes square, and a tank to correspond, make our hand jig- ıg set sufficient to answer our requirements. The machine he, purchased from the Mechanical Department has oved of great service and enables us to have work done re which we should otherwise have been obliged to send t at an increased expense. The iron sampling floor has en extended, giving about double the former area. The mpressor previously installed has been piped up and com- essed air is available for various purposes in the laboratory

work. The large 7 x 10 inch Blake breaker which was installed last year has done excellent work and shown its superiority over its predecessor. The Triplex rolls have been experimented with to some extent, but they are not yet a fully demonstrated laboratory machine. An Allis-Chalmers wall feeder capable of handling large quantities of material was installed during the summer to be used especially in connection with the new pulsator jigs. The development of these jigs has been going on in the laboratory and two models are now available for experimental work.

In making a pyritic run last year it was found that the tuyere-area of the blast furnace was not sufficiently large. To correct this, three 3-inch tuyeres have been added to the four 2-inch tuyeres with which the furnace has so far been provided. In connection with this work new and larger air pipes have been put in from the blower.

The new soft coal assay furnace, the laboratory crusher, and the disc grinder which were installed last year have not only given great satisfaction to the Assaying Department, but have also been very useful in the ore-dressing and metallurgical work.

Changes in Work of Instruction.—The time assigned for lectures and laboratory work in metallography has been increased. Many new diagrams have been prepared for the lectures in metallography and non-ferrous metallurgy, and they have been photographed to enable the students to obtain copies at a very low price, thus doing away with much drudgery in the class room.

Beginning next term a new course, Metallurgy of Engineering, will be given to the students of Course XIIIA. It is to cover the industrial use of fuels and the production and properties of metals and alloys used in construction. The changes inaugurated last year in the metallurgical laboratory have proved very satisfactory. It is proposed to add next year, to the typical operations so far carried through, the process of converting matte.

ourse Scheme.—A marked improvement has been made he revision of the Course scheme and it is now felt by the ɔartment to be in more satisfactory form than for many rs. The radical changes which have come about are as ɔws: One year of language has been dropped and miner- ɡy has been moved forward a year. The three options retained, but Option 3 becomes more distinctly a special logical option to be taken by those men who have a strong lination toward geology. Options 1 and 3 are uniform to the end of the third year. Time for exercises and paration has been made uniform for the various op- ɲs. Applied mechanics is now all finished in the third ɪr by all options. Physical laboratory is begun in the ond year. With the additional time gained by the drop- .g of a year of language, an increase is obtained in second ɪr English, European history, hydraulics, assaying, in new ɪrses in sanitary science, electrical laboratory, and forg- ;. Adequate time is provided in each term for chemical ɔoratory, and the subject of analytical chemistry is fin- ed by all except Option 2 at the end of the third year. ɔ gain all this it was necessary to transfer the mineralogy ɔm the second year to the third year and advance geolog- ɹl subjects correspondingly.

As soon as the necessary arrangments can be made the bject of surveying now given in the second year is to be ɪnsferred to the summer. By vote of the Faculty this mmer school is to be held between the second and third ars, although for the Mining Department the better time ɔuld be between the first and second years. When this ɪange comes it will make surveying instruction more com- ete and satisfactory and at the same time give additional ɔurs during the school year.

On account of the short time allowed for fire assaying in ɪe schedule it is suggested that an optional course in ad- ɪnced fire assaying be added to the curriculum as soon as ɔovision for it can be made. This course should be of

value to men who wish to take up this line of work and would also help to train men for assistants in our laboratories.

Thesis Work.—Among the theses of last spring the following perhaps deserve special mention: Three theses upon concentration of ores from Cobalt, Ontario. This is a very live problem and the results were satisfactory. A thesis on the washing of Mexican coal which yielded valuable results. A thesis on South African gold ore which marks the beginning of our experimental work upon this lot of ore. Mr. Tse's Master's degree thesis on the Wilfley table, and also Mr. Wen's Master's degree thesis on heat formation of some ferro calcic singulo silicates.

Advanced Students.—There are no candidates for the Master's degree this year, but two men are doing advanced work. Professor Katsura, who comes to us from the University of Tokio, has studied in the schools of Europe and has made an extensive trip through the metallurgical plants of the United States during the past summer and now will spend a year with us studying our methods. Mr. James A. Grant, who has been engaged in practical coal mining in Montana, is making a special investigation at the Institute on the relation of dust to explosions in coal mines.

Assistants.—Messrs. Lowry D. W. Bender, Charles A. Gibbons, Jr., and Leon A. Dickinson have left. This year Mr. Henry R. Batcheller and Mr. Thomas G. Chapman have been secured as Assistants in Ore Dressing; Mr. Frederick Jaeger as Assistant in Metallurgy, and Mr. Edward T. Almy, Jr., as Assistant in Assaying. The latter is a new appointment and Mr. Almy is especially fitted for the work, having had considerable outside experience. Owing to changes in the tabular view for next year which brings all of the assaying into the second term it may be necessary to increase the number of instructors in Assaying. In regard to Mr. Batcheller circumstances made it desirable for him to spend the winter in Boston and the Department considers it especially fortunate in securing the services of such an experienced man.

udents.—The student numbers remain about the same r last year, namely, thirty each in the third and fourth s, and thirty-five in the second year.

mmer School.—For the first time since 1871 there has no summer school. It was found that positions for rgraduates during the summer had been obtained in numbers that all students in mining who applied for tical work last summer were able to get it. The De- ment feels that it is better for a student to spend the le summer in practical work than a month in a summer ol. It will be the policy of the Department to offer summer school in the future only when five or more men y for it. The efficiency of the teaching appears to be ed very much by the experience which a student thus s during the summer and it is a question whether a stu- should not be required to have spent at least one sum- in practical work before he takes his degree.

ositions for Graduates.—The graduates of last year ob- ed positions very quickly and applications for men have e to us which we could not fill. This state of affairs probably continue with the general prosperity of the ntry. The Department has received several applica- s for teachers and it is along this line that we have special culty in supplying men.

une Reunion.—A large number of the former students the Mining Department returned for the Reunion and ified to the progress that our graduates are making in ious parts of the world. The graduates of this Depart- nt are perhaps more widely scattered than those of any er department of the Institute.

Professional Work.—Professor Richards made an extensive during the summer, visiting concentrating mills in Col- do, Arizona, Utah, Montana, and Ontario. He also made visit last February to a concentrating plant in Pennsyl- nia. Professor Hofman carried on last summer some large- le experiments with the Longmaid-Henderson process

for the treatment of sulphide copper-nickel ores at the works of the Pennsylvania Salt Manufacturing Company, Philadelphia. Professor Locke spent the summer largely on professional work and made trips to New York state in connection therewith.

Gifts.—Mr. W. A. Paine presented a copy of Steven's Copper Handbook for 1908 and Mr. E. D. Mellen a Wagner Mica Plate Electro-static Machine.

ROBERT H. RICHARDS.

DEPARTMENT OF ARCHITECTURE.

The present school year of the Department of Architecture opened with a second-year class of forty-three, the largest number of students with one exception that this class has ever recorded. There are nine students in the graduate course, of which five are candidates for the advanced degree. The universities and colleges continue to send us a large quota. There were newly registered with us this term graduates from Brown, Dartmouth, Harvard, and St. Louis universities and from the State Universities of Illinois, Nebraska and Oregon; one from the Mississippi Agricultural and Mechanical College, one from Radcliffe, and one from the Rhode Island School of Design.

The curriculum was readjusted last winter so as to permit moving a large part of the preparatory technical work from the third to the second year. More opportunity will thus be afforded in the last two years for studies of a strictly professional nature, and a broadening of the course in the History of European Civilization and Art. The first and second year students are now working according to this schedule.

The Option in Architectural Engineering is being taken by an unusually large number of students. Its graduates are always in great demand, and to the architect who leans

:e to the construction side and is fond of mathematics
; course offers excellent opportunities.

The Rotch Travelling Scholarship, giving opportunity for
) years' study in Europe, was this year awarded to
. Horace G. Simpson, '03.

The Rotch Prize for the regular student in the Depart-
nt of Architecture at the Institute was awarded this year
Mr. Lester H. King; the Prize for the special student was
ided between Messrs. Louis Svarz and Kenneth E. Car-
ıter. Messrs. King and Carpenter are now following the
duate course.

The two Boston Society of Architects' Prizes of fifty dol-
s each were awarded to Mr. Alvin F. Menke, a regular
ident, and Mr. Louis Svarz, a special student.

The 1909 Travelling Fellowship of one thousand dollars
s won by Mr. Ralph J. Batchelder in competition with
ıe others. Mr. Batchelder is now in Paris after six weeks'
ıvel in England. He is following a course laid down by
e Department.

Mr. Andrew N. Rebori, the beneficiary of the 1908 Trav-
ing Fellowship, returned a month ago. His work accom-
shed while in Europe now hanging in our exhibition room
most interesting, and is a good example of the value of
is opportunity to the student of architecture for rounding
his school work. Mr. Rebori's drawings show great
ill in draughtsmanship and appreciation of color. His
eatest effort, a large drawing in color of a part of Raphael's
)ggia in the Vatican, he leaves to the Department.

I again take this opportunity to call attention to the gen-
)sity of Mr. Guy Lowell, without whose help this fellow-
ip could never have been started, and upon whom its suc-
ss depends.

The prize of the American Academy in Rome, which is the
ghest in value and in honor offered to American architect-
al students, was won by Mr. Edgar I. Williams, '08, last
nuary. In the preliminary competition, in which nine

of the American schools of architecture were eligible to join, the number of competitors was reduced to four, of which three were from the Institute. The final competition gave the prize to Mr. Williams. Mr. Williams also completed the graduate course and gained the Master's degree. He is now in Rome at the American Academy.

A gift of fifty valuable books formerly belonging to Mr. Alfred Greenough was made to us by the heirs of Mr. Charles Henry Parker. We were asked to have a book plate inserted in each book to bear the inscription, "From the Alfred Greenough Collection." This has been done. The greater part of Mr. Greenough's collection was given many years ago by Mr. Parker to the Museum of Fine Arts.

Mr. David A. Gregg, so well known in the profession for his expertness in architectural rendering, and who has served loyally the Department during twenty-two consecutive years teaching this subject, presented the Department this term with a large pencil drawing beautifully done from one of Bacon's sketches of the Assos Expedition.

An interesting event to the Department was the visit of Professor Reilly, Professor of Architecture at the University of Liverpool. He had come to America to study our schools of architecture. He was much impressed by our methods, and took away a number of examples of our student work in design.

Mr. William F. Dolke, who is a half-time instructor, helping mainly in Option 2, has shown himself very capable and is doing good service in that course where it has been most needed. Mr. Tashjian will give next term a short course of lectures on Reinforced Concrete Construction.

The first number of the third volume of the Technology Architectural Record will make its appearance in December. Its scope has been enlarged to embrace illustrations of work accomplished in actual practice by our former students, and more space will be given to the subject of Architectural Engineering. It will publish the investigations of

nstitute laboratories in subjects of interest to the archi-
which until now have appeared only in the Quarterly,
ıtly discontinued, or in scientific journals.

much depends upon our ability to offer a travelling
wship as a reward for scholarship that I must make my
lar appeal for it. As you may not know, ours is the only
itectural school of any standing in this country that
ot offer a yearly prize of this kind, and we are the old-
chool besides. To this end we should have a travelling
wship of the value of fifteen hundred dollars; one thou-
of which should be paid to its beneficiary for foreign
y and five hundred as a salary for six months' instruc-
at the Institute immediately upon his return to this
ıtry. His duties as an instructor should be to devote
self impartially to our second, third, and fourth year classes
lesign. Such an association of our students with one of
recent graduates, only a little older than themselves,
) had achieved conspicuous success and would show how
had attained it, would be invaluable; and this instruc-
ı would come at the opening of the school year just at
time when the aid of fresh young talent would be most
)iring.

ı further improvement of our Course must be to bring
students into more intimate association with the fore-
st practicing architects of the day, whom they are to
ceed in the next architectural generation. We should
ve the History of Modern Architecture told to our fourth-
ır men by the most distinguished practicing architects of
day. We should be given the opportunity to invite them
tell the story of their own work, two or three lectures from
:h; say fifteen lectures in all. In no better or more in-
esting way could this intimate and most valuable con-
ction be brought about of theory and practice; of the
ıdent and the architect.

F. W. CHANDLER.

DEPARTMENT OF CHEMISTRY AND CHEMICAL ENGINEERING.

The record of the past year is one of general prosperity and successful achievement, for which credit is due to the loyal and efficient service on the part of the entire staff of instruction. The personnel of the staff has undergone considerable change with respect to its junior members, two instructors and nine assistants having resigned at the close of the year, of whom seven entered technical positions, one accepted another teaching position, one a position as research associate, and one (Mr. Paul S. Fiske) was granted the Dalton Fellowship for study abroad. Among the number thus resigning was Dr. Peter S. Burns, who has given the Department long and devoted service, and has made many friends among our students and graduates. The vacant instructorship in Inorganic Chemistry has been filled by the appointment of Dr. Stroud Jordan, of the University of North Carolina, while that in Theoretical Chemistry is occupied by Dr. Fred H. Heath of Yale University. Of the ten new assistants in the Department, three are graduates in Chemical Engineering, five in Chemistry, one in Sanitary Engineering, all of the class of 1909, and one is a graduate of Harvard University. The other staff changes include the merited promotion of Dr. Augustus H. Gill from Associate Professor to Professor of Technical Analysis, and the transfer of Mr. Frederick R. Kneeland from Analytical to Organic Chemistry. It is a pleasure to report that Professor Sherrill is able to resume his duties in connection with the work in Theoretical Chemistry.

The number of students taking the Course in Chemical Engineering has increased to a marked extent, forty-eight being registered in this Course in the second year. On the other hand the number registered in the Course in Chemistry has diminished somewhat, although the second-year

ents in this Course number eleven at the present time.
; increase in registration in the former Course is attrib-
)le to increased interest on the part of our students in
mical Engineering as a profession, on account of the
ements made by various persons entitled to speak with
ıority regarding the important part which this profes-
seems likely to play in the more immediate future of
industries, and to the fact that students who have ex-
ısed an inclination to take up technical chemistry as a
work have been advised to enter this Course. A con-
:rable number of students from other colleges have also
ted this Course, thus adding to the numbers enrolled
:he higher years as well. Others of the incoming college
ı have entered the Course in Chemistry, and it is the
)e of the Department to be able to enlist the interest of
increasing number of able men in a preparation for a
eer of research in chemical lines or in the teaching of the
:nce, such as this Course affords, two fields which also
sent much of promise and attractiveness just now.

:t has again been necessary to make alterations in our
oratories to meet the unavoidable demands upon them
the increase of students taking chemical subjects. A
rtion of the Laboratory of Inorganic Chemistry on the
per floor of the Walker Building has been rearranged to
:ommodate combustion furnaces for the work of the third
d fourth years, and the combustion room on the third
or has been thrown into the Laboratory of Inorganic
ıemistry on that floor. This change was made impera-
'e by the increased number of first year students who
:cted Courses in which chemical subjects are given in the
gher years, this group of students being now treated by
emselves in the second term of the first year. It is prob-
)le that even the enlarged laboratory will be filled this
:ar.

The very difficult conditions under which the work in
nitary chemistry has been carried on have been emphasized

in recent reports, and it is a pleasure to record that slight relief from the most oppressing conditions has been afforded by the division of the laboratory by partitions in such a way as to provide separate rooms for the Air and Water Analysis, on the one hand, and Food Analysis on the other. A slight additional space is gained through the sacrifice on the part of Mrs. Richards of a considerable part of her office. The advantage to the work in water and air analysis is considerable, and the addition of an auxiliary ventilating fan now makes it possible to carry on this work under relatively favorable conditions which have been lacking for some time. Advantage has been taken of the opportunity to refit this portion of the laboratory with a modern equipment including approved electrical heating and lighting devices which will not only permit of more efficient instruction, but will permit of research work in these lines. A part of this added equipment has been provided through the generosity of Mrs. Richards and her friends. An additional half-time assistant has also been provided for Air and Water Analysis, and also one for Food Analysis. While considerable in the way of efficiency has been gained by these changes, the congestion is still great and it is a difficult problem to accommodate the number of students entitled to instruction in these subjects within the combined space of the two laboratories.

During the past year the permanent equipment of the Department has been increased by the purchase of an electrically lighted and heated polariscope for use in food analysis; a thoroughly equipped Zeiss microscope for use in metallographic work in the Research Laboratory of Applied Chemistry; a gas furnace and blower for use in the Industrial Laboratory; an additional Junker gas calorimeter; electrically heated stills for water analysis, and an electrically driven pump for the supply of air-blast and suction to the Chemical and, in part, to the Physics and Mining Departments. Some progress has also been made in completing the more valuable sets of periodicals in the

ım Ripley Nichols Chemical Library which are not to
ınd in other libraries near Boston.

memorial tablet to the late Dr. Thomas M. Drown,
ssor of Analytical Chemistry at the Institute from 1885
95, who was also in charge of the Department for nearly
ame length of time and later President of Lehigh Uni-
ty, has been placed in the Chemical Library through
ıid of a memorial fund, of which the major portion has
used to erect a social hall, known as Drown Memorial
at Lehigh University.

ıe Department is indebted to the following firms for
of color samples used by Professor Mulliken in the
aration of the third volume of his work on the Identi-
ion of Pure Organic Compounds, now in press: Cas-
Color Co.; Badische Co.; Kalle & Co.; Farbenfabriken
ılberfeld Co.; A. Klipstein; Meister Lucins and Brünig;
in Aniline Co.; and Leirnstein & Co.

he Department was again requested to name a second-
student to enter the laboratories of Harrison Brothers
Company for summer work. Mr. John R. Bell of the
ırse in Chemical Engineering was recommended and,
ı Messrs. Lunt and Christie, the two previous nominees,
ıt a portion of the summer in technical work at Phila-
ɔhia, with generally favorable results.

'he Courses in Chemical Engineering and Chemistry have
undergone any material changes during the past year.
ere has been an increased effort throughout the Depart-
nt to secure closer contact between instructor and pupil
ough more frequent conferences and increased class-
m instruction. This is particularly true in the instruc-
n in the first year, in which somewhat radical changes have
n made with a view to securing more systematic study
the part of the student through the elimination of some
the formal examinations, and by a better arrangement
the instructor's time in the laboratory. While some
the former difficulties have been lessened or removed, some

new ones have appeared, as is inevitable in such cases, and a final decision as to the most desirable procedure has not yet been reached.

In each Report for the last few years, particularly in that of last year, the urgent need for increased and better arranged space for the Departmental work has been emphasized. It is evident that the desired relief cannot be given until certain broad questions of general policy have been settled and it seems unnecessary to present again those appeals the justice of which there is reason to believe is generally acknowledged. It is, however, a duty to point out the fact that the number of students entering the professional Courses in which chemical subjects are offered is increasing, particularly in the Courses in Chemical Engineering and in Sanitary Engineering, and that in the latter Course some much-desired additional chemical instruction has been recently introduced. More college men also are coming to us each year. Our laboratories of analytical chemistry are, however, completely filled this year; the laboratories of organic chemistry, already operating at a disadvantage, will be overcrowded next year; in the year following, if not earlier, the laboratory of industrial chemistry will not accommodate the students entitled to instruction; and the same may be true even next year of the laboratory of water analysis, in spite of our attempts to give relief to this branch of the work and possibly in theoretical chemistry as well. Over against these demands, which, so far as can now be determined must be met, stands the fact that there seems to be no more space within the present buildings of the Institute which it is proper, (if it is even possible) for the Department to ask to have appropriated to its use, or if appropriated, would even approximately serve our purposes. The problem of properly accommodating our students and of maintaining the efficiency of our instruction is, therefore, increasing in difficulty to a point which baffles our best efforts to find a solution under existing general conditions, and it is the hope

he members of the Department that the situation here ented may constitute one important ground for an early rmination of these general policies upon which the pos- e erection of new quarters for the Department must first end.

H. P. TALBOT.

THE RESEARCH LABORATORY OF PHYSICAL CHEMISTRY.

uring the past year the Research Laboratory has been er the charge of Professor Gilbert N. Lewis; and its tinued progress has been largely due to his devotion to interests and to his ability as an investigator. All the earch Associates in the Laboratory, Dr. William C. Bray, Charles A. Kraus, Mr. Roy D. Mailey, Mr. Arthur C. cher, and Mr. Richard C. Tolman, have also contrib- l very greatly to the success of the research work.

rofessor Lewis is pursuing, with aid of assistants and luate students, as one of his main lines of research, the erimental determination and computation of a system values for the free energy of chemical substances anal- us to the system of values for the total energy previously eloped by thermochemical investigators. The problem ne of fundamental importance to the science of chem- y, since from the free-energy data for the substances the ilibrium of the chemical reactions in which they are in- ved can be computed.

uring the past year Professor Lewis, in conjunction with . Richard C. Tolman, has also given much attention to newly developed basic principle of physical science known he Principle of Relativity, and they have published arti- upon the subject which have attracted much attention n physicists.

r. William C. Bray has completed the work upon the

new system of qualitative analysis including the rarer elements, which had been in progress in the laboratory for a number of years under the direction of Professor Arthur A. Noyes. The work has already been published in scientific journals, and will be issued in text-book form during the coming year.

Dr. Kraus and Mr. Mailey have been engaged in an investigation upon alternating current rectifiers. The problem is one of great technical importance; and the results already attained make it certain that the investigation will prove an important contribution to the subject.

The physico-chemical research on the properties of salt solutions in relation to the Ionic Theory which, with the view of developing that theory, has been carried out for a number of years under the direction of Professor Noyes, has been continued during the past year with the assistance of Mr. Melcher, Dr. Bray, and Mr. Gale. It has again been aided on the financial side by a grant of $3,000 made to Professor Noyes by the Carnegie Institution of Washington.

With the opening of the new school-year the number of research workers in the laboratory has been largely increased. Two new men have been added to the staff as Research Associates, Dr. K. George Falk from Columbia University, and Dr. William D. Harkins from the University of Montana. Mr. Franklin L. Hunt, M. I. T. '09, has been appointed Research Assistant in place of Roger D. Gale, who has taken a technical position. Three new candidates for the degree of Doctor of Philosophy have also entered upon research work in the laboratory.

ARTHUR A. NOYES.

THE RESEARCH LABORATORY OF APPLIED CHEMISTRY.

e experience of the year just closed has, in a large meas-
justified the foundation of this Laboratory, inasmuch
e opportunities which have been offered to us to serve
the Institute and the manufacturing public have been
than our facilities make it possible to undertake. The
mental idea that chemical research carried on with a
to obtaining results of immediate value upon some sub-
f interest to one or many industrial organizations has
shown to be a practical one, and to provide a plan ca-
of great extension so soon as adequate laboratory facil-
re available.

laboratory course for engineering students devel-
by Dr. Burns, as mentioned in the report of last year,
een put into effect with some of the Institute classes
gratifying results. With the changes suggested by
ence, this work promises to provide a series of experi-
with which to teach the chemical properties of the
commonly employed engineering materials, and the
important chemical reactions to which such materials
sceptible.

investigation of the difficulties incident to the manu-
e of galvanized sheet iron, undertaken on behalf of
nerican Sheet and Tin Plate Co., has progressed in a
satisfactory manner, and this work will be carried
h the present year by Mr. Raymond E. Drake.

ported by funds supplied by the I. E. du Pont de
irs Powder Co., the Laboratory has commenced a
ehensive study of certain phases of the supply and
tion of glycerine. Mr. John S. Coye is in charge of
vestigation which it is expected will extend beyond
sent year.

nvestigation of the properties and possible uses of the

metal Cerium is being carried on by Mr. Alcan Hirsch. Through the courtesy of the Department of Electrochemistry this Laboratory has been able to use the splendid equipment of that Department for the electric furnace work, and encouraging results have been obtained.

A paper published by this Laboratory last spring on Paint and Varnish Films as Accelerators in the Corrosion of Metals has attracted much attention, and with the co-operation of the American Society of Testing Materials and the American Paint Manufacturers Association, the subject is being thoroughly investigated by Mr. Maurice T. Jones, Jr. Few problems are of more general interest or of more immediate importance than an adequate protection for iron and steel structures. Work already published by the Laboratory has done much to establish the conditions which must obtain in order that iron and steel will not deteriorate through corrosion, and the results of the present work are awaited with interest.

WILLIAM H. WALKER.

DEPARTMENT OF ELECTRICAL ENGINEERING.

Important changes have been made in the Department staff since my last report. Professor Harry E. Clifford resigned to enter a professorship in Harvard University, and his place was filled by Dr. Harold Pender. Associate Professor George C. Shaad resigned to become head of the electrical enineering department in the University of Kansas, and his place was filled by the appointment of William E. Wickenden to an assistant professorship.

Dr. Pender is a graduate of Johns Hopkins University, class of 1898. He received the degree of Doctor of Philosophy from the same university in 1901, after graduate study in physics, electrical engineering and chemistry. He gained scientific reputation for his thesis and his succeeding researches on the magnetic effect of moving electrostatic

ges of electricity, and was called to Europe to demon-
te the results of his researches to European scientists.
n returning to this country in 1903, he entered profes-
al service in electrical engineering and has been asso-
d with important electrical engineering installations.
s author of a number of articles and monographs which
appeared in the Philosophical Magazine, Journale de
ique, Comptes Rendus of the French Academy of Sci-
, Electrical World, and other journals. Professor Pen-
duties in the Department include the direction of the
rtant undergraduate course in the Elements of Elec-
l Engineering which is provided in the curriculum for
hird year students in Electrical Engineering, Electro-
istry, and the Naval Constructors, and which is at the
lation of all of our professional instruction in electrical
eering. His duties also include advanced lectures on
nating Currents and the Problems of the Electrical
smission of Power for graduate students, and the direc-
of investigation and research carried on by advanced
nts.

fessor Wickenden is a graduate of Denison University,
of 1904, from a course strong in mathematics and phys-
He thereafter taught for a period and then entered
graduate study of physics and electrical engineering.
he past three years he has been on the staff of the elec-
engineering department of the University of Wisconsin,
he made an enviable reputation as a teacher. He
author of several articles on electrical engineering sub-
and has a book in press which deals with the impor-
subjects of illumination and photometry. Professor
nden's duties include the instruction of fourth year men
fessional studies like Central Station Operation and
gement, Electric Railways, and Technical Reports.
o has charge of some instruction in electrical engineer-
r Naval Constructors, and the instruction of advanced
ate) students in the design of generating stations and
ution systems.

At the end of the first term of the Institute year 1908–9, Instructor Charles H. Porter and Assistant Clarence C. Knipmeyer resigned, the latter to go to a desirable position in the Rose Polytechnic Institute. The vacancies were filled by the appointments of Messrs. Lester W. Brock, Technology '07, and Oliver S. Jennings, Brown '06 and Technology '08 as assistants for the remainder of the year. It has seemed desirable to go to some inconvenience rather than refuse to release in the middle of the year younger men of the staff who may have calls to greater responsibilities in teaching or scientific research elsewhere. This is on the theory that our duty lies in aiding the interests of engineering teaching and of scientific research anywhere in the country, in addition to carrying on our own teaching and research in the most effective manner practicable.

Mr. Harry L. Burgess, Technology '08, was also appointed an assistant for the second term on account of the absence of Professor Smith, who was away on leave. Instructor Harold G. Crane resigned at the end of the Institute year 1908–9, to become Instructor at Harvard University. Evan J. Edwards, Charles W. Green, Ralph G. Hudson, and George B. Thomas were promoted from assistants to instructors. Messrs Robert C. Glancy, Technology '09, George H. Gray, Technology '09, Edgar P. Slack, Technology '08, and Isaac H. Van Horn, Wisconsin '09, were given one year appointments as assistants.

Associate Professor Harrison W. Smith was granted leave of absence for the last term. He spent the time in a trip around the world. Sailing from San Francisco on February 2, 1909, he touched at various Pacific islands port on the way to Batavia, Java. Here, he collected specimens and made photographs. Returning to this country by way of the Suez Canal, he arrived in this country in the latter part of September, bringing scientific specimens and an extended collection of photographic negatives.

The Department Staff now consists of two Professors,

e Associate Professors, one Assistant Professor, five In-
:tors, and four Assistants. The reduction in the pro-
ion of first year Assistants, compared with former years,
decided improvement and makes for the stability of the

ith reasonable provision for promotions to the staff,
proper additions to meet the requirements of addi-
l hours of teaching, the staff ought to have a steadily
asing influence in the electrical engineering profession.
: more rational process of promoting the younger men
e staff than has heretofore been in operation needs to
lopted before the most effective results may be hoped
It is obviously not for the welfare of the Department
)f the Institute to continue the scale of salaries for the
ger men so low and the rate of promotion so slow that
bler individuals feel compelled to turn away from teach-
:tudy, and research and to go into purely commercial
gs. Our instructors are several years from the day of
graduation and are between twenty-four and thirty
of age,—an age at which it is natural for young men to
ısly consider marriage; but our instructors' salaries
diculously inadequate to support such ventures. The
iary deficiency may be partially overcome by each
dual turning to "pot boilers" which are aside from his
line of teaching, study, and research; but the distinc-
ınd influence of the Institute must ultimately be sus-
l by the scientific attainments and civic accomplish-
of the younger men who may gradually rise to more
tant positions, and it therefore can be only a misfort-
t this critical time of their service, to crowd these men
process of pecuniary starvation into fields which lead
away from productive study and research.
I pointed out two years ago in a similar communica-
ngineers in academic life possess undeniable large com-
ions for the advantages otherwise found in engineer-
actice and the executive positions of industrial life,

but the responsibilities which they bear to their students and to the public are heavy, and the cost and effort required to maintain an adequate knowledge of the progress of science and engineering in their respective branches are large. The men who can bear these duties most fruitfully are also men who can bear important responsibilities and command unusual consideration in industrial affairs. If we are to have the opportunity of selecting from our younger men those of peculiarly admirable qualities as leaders and teachers, we must be able to offer rational salaries and rates of promotion within a few years after graduation to those who have properly prepared themselves for our service.

The undergraduate and graduate instruction of the Department is steadily progressing. The numbers of students are increasing in both the undergraduate and graduate work. The improved curriculum approved by the Faculty two years ago went into use with the third year class in the fall of 1908 and has now come into use with the fourth year class. I believe that it gives an unusually well balanced electrical engineering course, but that some additional modifications may be made with wisdom. These will receive the consideration of the Department from time to time.

The policy of the Department is to do work for the Course VI. students as thoroughly and wisely as we know how, and to also undertake instruction of students of other Courses whenever the curricula of those Courses afford the opportunity. Changes made in several other Courses within the last two years have consequently imposed on the Department, especially on the laboratories of the Department, responsibility for the instruction of a considerably larger number of students than ever before. Taken in association with the increasing numbers of students in the upper classes of Course VI., this will in another year require us to take care in our laboratories of perhaps twice as many student-hours of instruction as were imposed on the laboratories three years ago. The staff is too small to bear the burden and I

ll have to ask for more assistants in my next estimate.
: increased instruction which we are giving to students
)ther departments seems a matter of importance to the
fare of the Institute, as the uses of electrical power are
ıding nearly every branch of industry, and all engineers
uld have some laboratory instruction in electrical science.
t is significant that forty per cent. of the men graduat-
from our Electrical Engineering Course last June had
/iously received college degrees and had thereafter spent
ı one to three years in electrical engineering studies with
It is also a matter of marked interest and significance
: sixteen per cent. of the men who graduated from our
:trical Engineering Course last June became teachers
lectrical engineering or physics. It is surely an admir-
: ideal for young men to enter the field of teaching; and
:lieve the Department may justly cultivate such an am-
)n among its best students without lessening its direct
ıence on industrial affairs.

)me distinct improvements have been made in the lab-
ory equipment during the past two years, but we still
: crying needs. In the way of special apparatus, an
ıuate storage battery is very desirable. I hope that this
be soon afforded. It would be particularly useful as
)urce of steady current for purposes of research. The
age regulation of the service plant will be improved by
application of the recently purchased Tirrell regulating
ıratus, but the absolute steadiness of battery current
:eded in many kinds of work. The Department library
needs more liberal support and will soon need more
ı.

respect to the floor space for our work, we are particu-
cramped in the Standardizing Laboratory, also for
of small rooms for research and for want of at least one
: class-room assigned to the exclusive use of the Depart-
t. During the recent vacation we had two small lab-
)ry rooms divided by partitions, thus making four re-

search rooms out of what had been two. We also converted Mr. Lyon's office into a lecture and seminar room for advanced classes, at the same time dividing up the room which had been used for the latter purpose into several offices for laboratory instructors. These changes have added considerably to our convenience. A store room is now to be arranged underneath the lecture-room, which will give some additional relief.

Mr. Frederick P. Fish, of the Corporation, again generously provided funds for defraying the expenses of inspection visits to other engineering schools by members of the staff, and Mr. Charles A. Stone, also of the Corporation, contributed funds to the same end. Professors Laws and Shaad and Instructors Edwards and Green consequently made inspection visits to several schools. Brief written reports of the observations have been made to me and I will transmit abstracts of them to the donors of the funds. A small balance yet remains to be used, and I have, therefore, not yet made my accounting to the generous givers. I believe these inspections are sure to bring us multiplying returns.

Of the same order is attending meetings of the professional societies. During the past year one member of the staff attended the annual convention of the American Institute of Electrical Engineers, one member attended the annual convention of the National Electric Light Association, and several attended the annual meeting of the Society for the Promotion of Engineering Education. I served on the Committee on Education of the American Street and Interurban Railway Association, which formulated and reported a plan for suitable apprenticeship and vocational school processes to be adopted by electric railway companies. I have been and am serving on certain committees of the American Institute of Electrical Engineers. The participation in the proceedings of such societies seems to me a part of our duty to the electrical engineering profession and the electrical en-

ering industries, and I do not believe that we are yet ing our full obligations; but our present limitations of ies and of time necessarily curtail such activities. eover, the staff is not without civic activities which ume time and thought.

searches which have been carried on during the past , or are being carried on by, or under the direction of staff embrace investigations of the error in photometric . due to the concentration of light rays by reflectors; ive precision of Lummer-Brodhun and grease-spot pho- ter screens for commercial work; the effect of heat treat- on silicon steel; the strength of wooden poles and the t of wind pressure and changes of temperature on wire s; the capacity and self-induction of transmission lines; attenuation, distortion, and reflection of the current s in telephone circuits; a method for determining the acteristics of "current transformers;" and the develop- of a mechanical rectifier of single-phase alternating nts; besides some investigations and tests for commer- purposes.

ie Department has received a number of gifts during the These include the money to defray the expenses of inspection visits to other engineering schools already ibed, and money to defray the expenses of two dinners e Electrical Engineering Society at which Mr. Louis A. uson, Technology '88, President of the American Insti- of Electrical Engineers, and Mr. Frank J. Sprague of ric railway fame, were respectively present and ad- ed the Society. Mr. Charles L. Edgar of Boston pre- d the Department with an interesting framed photo- a of Mr. Edison and Dr. Steinmetz sitting in conversa- which will hang in the reading-room. The General ric Co. made liberal concessions in the price of the tur- generator outfit which is being installed in the service . The Pittsburg Transformer Co. presented a trans- er of 5 kilowatts capacity; Stone & Webster presented

wooden poles for use in the researches on the strength of poles; the American Sheet and Tin Plate Co. presented sheet steel for use in the researches on the effect of heat treatment on silicon steel; and various other gifts of a corresponding nature have been received.

DUGALD C. JACKSON.

DEPARTMENT OF BIOLOGY.

The Department of Biology offered this year for the first time a regular course by Professor Winslow, in Industrial Hygiene and Sanitation, consisting of lectures and conferences dealing with the various prejudicial effects of factory life upon health, including occupational accidents, industrial poisonings, and the effects of defective ventilation and dusty trades upon the prevalence of tuberculosis and other diseases.

A course in Chemical Biology was also given by Professor Phelps for the first time. In this, an attempt is made to interpret in terms of physical chemistry certain fundamental phenomena associated with life processes.

In addition to creditable researches in Sanitary Science made by the younger members of the Staff and referred to in the next section under the report of the Sanitary Research Laboratories and Sewage Experiment Station, a valuable investigation was made during the summer by Professor Prescott, in collaboration with Professor R. S. Breed, of Allegheny College, who came to Boston and gave up a large part of his summer vacation for the purpose, upon the occurrence and distribution of leucocytes (white blood corpuscles) in milk and cream. This investigation bids fair to bring about a considerable change in the determination and interpretation of the presence of these interesting bodies in one of the commonest and most important articles of human food, and is sure to be received with wide-spread interest by physiologists, dairy experts and sanitarians. When

ytes were first observed in milk they were thought to
r that the cows from which they came must be more
s diseased, but this work of Professors Prescott and
confirms and establishes the more recent idea that
ytes are common constituents of normal milk and

growing interest everywhere manifest in questions
ng the conduct of life and especially the life of modern
unities with their vexed problems of public health,
safety, public comfort and public convenience, is one
striking features of an otherwise industrial age. And
ponse to this interest we find the attention of an in-
ıg number of students turning towards professions like
ry engineering and applied biology, which naturally
:er to this newly felt want, and finding in such service
satisfaction and their support. It was perhaps inevi-
that the first struggle of a scientific and industrial age
l be to liberate mankind from the servitude of heavy
al labor, and to give it food and freedom. Now, how-
that man has mastered to a large extent his lifeless
ınment, he appears to be turning with equal interest
ds control of the living world. The increase of inter-
biology is, however, thus far mostly confined to gradu-
tudents from other colleges and universities, for the
: which sends its younger sons to the Institute does not
:alize either what biology is, or what it is in the future
come. Some of these graduate students remain with
ıg enough to take our Bachelor's or Master's degree,
ıany, largely because of the exhaustion of their resources,
n only one year. Even these, however, readily find
ons of usefulness in the public service or elsewhere and,
l to the regular graduates help to strengthen our an-
output, and add greatly to the serviceableness of the
rtment.

e personnel and material equipment of the Department
remained practically unchanged during the year. The

Degree of Bachelor of Science was awarded in June to five candidates, two of whom have returned as candidates for the Degree of Master of Science. We now have four candidates for advanced degrees, one for the Degree of Doctor of Philosophy and three for the Degree of Master of Science.

WILLIAM T. SEDGWICK.

SANITARY RESEARCH LABORATORY AND SEWAGE EXPERIMENT STATION.

The work of the Sewage Experiment Station has undergone important changes and developments during the past year. The old Station at Albany Street had been practically outgrown and it has been made possible by the generosity of the donor, who has throughout supported the Station, to erect a new experimental plant much better fitted to the Station's need. The new plant is situated, through the courtesy of the City of Boston, on the land adjoining the Dorchester Pumping Station of the Boston main drainage works. Here ample room is available, and furthermore sewage is obtained directly from the main outfall sewer of the City of Boston without the artificial conditions created by the use of such small pumps as are necessarily used at almost all similar experiment stations. The new plant includes three trickling filters, equipped with the gravity distributor devised at the old Station, with Waterbury sprinkling nozzle, and with a travelling distributor of the Fiddian type especially constructed in London for the use of the Station. There is also a sand filter working under normal outdoor conditions and having an area of approximately four hundred square feet. The plant includes in addition a septic tank and sedimentation tank of special design, and a Dibdin plate bed, the latter being well adapted for a study of the most advanced problems in the art of sewage treatment.

aboratory of the Station has been removed to Room
:e Building, thus bringing the work of the Station
contact with the work of the Institute student.
also been possible to broaden the work of the Sani-
search Laboratory by taking up specifically certain
s of ventilation and dust control which are of press-
ortance. The first question to be attacked is that
prevention of occupational disease among granite
and Mr. Royce W. Gilbert is making for us a care-
y of the dangers incident to this industry and of the
l methods of prevention.
ıctual conduct of the work of the Station remains
:rto mainly in the hands of Professor Winslow, as
t-in-Charge, and Professor Phelps, Resident Chem-
Bacteriologist, to whom is due the credit of planning
Station and supervising its construction. We are
lebted to Mr. Andrew D. Fuller, C.E., for valuable
and assistance on this side of the work.
her volume, the fifth, in the series of papers giving
ılts of the work of the Station and Laboratory, has
been issued. Most of the earlier volumes are
out of print, owing to the large and unexpected
l for them.
anonymous donor, to whom we stand indebted for
)ortunity to do this work, still maintains single-handed
ire enterprise. It is earnestly to be hoped, however,
:hers who realize what may be done for the public
and public welfare, not only by scientific investiga-
nd the dissemination of information, but also by the
ion of capable young men going out into all parts
world and ready and eager to apply the principles which
ave learned at the Institute, will be found to help
ntain and extend this work.

WILLIAM T. SEDGWICK,
Director.

DEPARTMENT OF PHYSICS.

During the last year there have been no such changes in the methods of instruction in General Physics and the Physical Laboratory as to call for especial notice, although for many years past continual modifications in the details have been made which, in the aggregate, largely increase the efficiency of our instruction. In the recitations, which accompany the lectures in General Physics of the second year, we are hampered in an endeavor to increase the number of sections and so to diminish the average, and especially the maximum, number of students per section by the lack of a sufficient number of recitation rooms and by the crowded state of the tabular view as well. The appointment of an additional instructor for the present year will, to some extent, remedy these difficulties by allowing more flexibility in the sectional arrangements.

A year since, in connection with this Course, there was introduced, largely as an experiment, a definite system of conferences similar to those instituted a year before for the benefit of certain courses in the first year. For this purpose the instructor sets aside certain stated hours for individual conferences with such students as are especially in need of advice, and their attendance is compulsory. The conferences are open, moreover, to all students desiring this. These consultations which are personal in their character are not intended primarily for the purpose of definite instruction, but rather to bring about a clearer mutual understanding between instructor and student, and to allow of such individual help as this knowledge may suggest. The results, on the whole, were very satisfactory and the system is well worthy to be made permanent.

A change which should be noted in the general laboratory instruction is the accomplishment of the long desired transfer of the beginning of this work for the Course in Min-

ngineering from the third to the second year. With evision of the schedule all students except those in ical Engineering will take their physcial laboratory in close connection with the corresponding lecture and room instruction to the mutual advantage of each. lesired increase of time in the second year for labora- vork to allow the introduction of certain work in elec- measurements, which was referred to in my report : year, has not as yet been found feasible.

: course of lectures on Heat, taken by all regular stu- in the third year, has been made to touch more closely ıitherto upon the applications of the principles and laws ıt agent to engineering problems. This is now possi- , was not formerly the case, since the students now enter ıstitute with some knowledge of physics.

ıve to record a continued steady increase in the appa- of the Department available for purposes of instruc- nd investigation. .Two important optical instruments ɔeen purchased from the income of the bequest of Mrs. ıtus Lowell, which is allotted to the purchase of physi- paratus.

: number and value of the instruments, which the s Laboratory owes to this source, have become so con- ble that I think it proper to put more formally on rec- list of these. It has been customary to apply this l appropriation to the acquisition of costly apparatus is likely to be of permanent value, rather than to pieces ıor importance.

following is a list of such, with the name of the maker ıe date of the purchase.

Cathetometer with two Telescopes; Société Génevoise, Geneva.
Automatic Air-pump; E. S. Ritchie & Sons, Brookline.
Koenig Spectrophotometer; Schmidt & Haensch, Berlin.
Michelson Interferometer; Gaertner, Chicago.
Landolt-Lippich Polariscope: Schmidt & Haensch, Berlin.
Littrow Spectroscope, Michelson's pattern; Gaertner, Chicago.
Weston Lecture Room Ammeter and Voltmeter; Weston Electrical Instrument Co., Newark.

1906. Ultra-violet Microscope; Zeiss Co., Jena.
1908. Abbé Crystal Refractometer; Zeiss Co., Jena.
1909. Brace Spectrophotometer; Schmidt & Haensch, Berlin.
1909. Martens Polarization Photometer; Schmidt & Haensch, Berlin.

The advanced work carried on in past years in the Laboratory of Heat Measurements, under the charge of Professor Norton, has been continued so that its equipment is now fairly adequate for the work in hand. Instruction is given to substantially all students of the fourth year, excepting those in Civil Engineering and Architecture, in the measurement of high temperatures, the determination of the heat of combustion of fuels, and the efficiency of heat-insulating materials. Furthermore, special instruction bearing upon their particular professional studies is given students in Metallurgy and Chemistry. During the past year, the students pursuing the short course in Concrete Design in the Architectural Department undertook some experimental work in this laboratory, in the study of the action of fire on Portland cement concrete.

Much experimentation has also been carried on in the way of measurements of the thermal conductivity of substances used for heat insulation at both high and low temperatures. Beginning with the thesis work of a graduate student in Architecture, there has been developed new apparatus for the study of the insulating value of the numerous substances now employed in protecting the steel work of modern buildings from fire. The precise methods of electric heating, together with the exceptional facilities which the laboratory possesses for high temperature measurement, have made possible the collection of valuable data on the effectiveness of the protection afforded by fire-proofing materials and methods. Likewise the study of those substances which are used for insulation in refrigerating devices, cold storage plants, and the so-called fireless cookers has been undertaken on specimens of considerable size. As a result the laboratory is now equipped to furnish instruction and to carry on research in these directions.

dy has been made of the physical effects of tempera-
on the materials used in building, and data have been
d concerning the physical properties of concrete,
brick, etc., at conflagration temperatures. In par-
the coefficients of expansion, the mechanical strength,
y, and specific heat of concrete at high temperatures
een the subject of much investigation. The ability
orced concrete to withstand sudden exposure to high
ature is now being studied, and numerous specimens
ns and columns of considerable size are ready for

additions to the apparatus of the laboratory during
ar include several pyrometers, a number of electric
es and rheostats, two new combustion bombs, and
tus for testing the thermal conductivity of materials
n construction. A 15 kilowatt transformer, with di-
secondary, has also been constructed, according to the
and specifications of Professor Derr. The avail-
working space of the laboratory has been somewhat
sed by the removal of the direct current generating
is being no longer necessary in view of the increased
ating current supply now available from the general
c power plant.

ing upon the recommendation of the Department and
ty, the Corporation of the Institute towards the close
e last school year decided to establish as a separate
e, the scheme of studies, which for the previous eight
have been the Electrochemical option of the Course in
cs (VIII.) and which has thus been constituted Course
—Electrochemistry. The new Course will continue
under the charge of Professor Goodwin, and the labo-
es of Electrochemistry will as heretofore form a por-
of the Rogers Laboratory of Physics.

may not be inappropriate at this time briefly to recall
urpose and leading features of this Course. As origi-
laid out by Professor Goodwin in 1901, it aimed to

supply an opportunity for students to obtain a combined training, at that time unprovided for at the Institute or elsewhere in this country, in the theory and practice of applied electricity and of theoretical and applied chemistry, the essential features of Courses V. and VI., together with a considerable amount of distinctly professional work in electrochemistry. It was believed that there would be an increasing demand for graduates having a training, such as that proposed, in the rapidly developing electrochemical industries of the country, and that such has been the case, is shown by the recent establishment of similar courses of instruction in a number of our leading universities and technical schools. At present there are fifteen students registered in the Course. The total number of graduates, 1903–1909, is twenty-five, all of whom have obtained good positions and some very important ones. While the Course was planned to lead up to professional work in electrochemistry in the fourth year, it was believed that the instruction in the fundamental studies of chemistry and electricty should be of so broad and thorough a character, that a graduate would be well equipped to enter other fields of work than that of electrochemistry in its restricted sense, if he so desired. That the curriculum, which remains in its essential features as originally planned eight years since, has satisfactorily met this requirement, is shown by the wide range of occupations of the present graduates. Thus while about one-third are engaged in strictly electrochemical and electrometallurgical work, another third are engaged in electrical, mining and general engineering, while the remainder are well placed in various bureaus of the United States Government, or are engaged in patent law, scientific research, or teaching.

The Course in Electrochemistry is necessarily somewhat rigorous in character, involving as it does a knowledge of the theory and practice of two sciences, chemistry and electricity, the latter highly mathematical in its nature. Only students of good ability have been advised to elect it, and

ttempt has been made to attract large numbers. In owing to the present congested condition of our lab- ɔries, provision has not been made for more than ten or ve students in the senior year.

ıe Electrochemical Laboratories, in which the advanced : of the Course is carried out, consist of two rooms in basement of the Walker Building. These were thor- ıly equipped in 1903, one with twelve desks provided every facility for electrochemical measurements of all s, the other with direct and alternating current electric ɜr, electric furnaces, etc., for testing technical processes fairly large scale. Since the establishment of the Lab- ɔry, it has been the policy to add each year such appa- s and accessories as would keep it up to date in its facil- for advanced instruction and research work. The most ɔrtant acquisitions during the past year are an induction ace, built by the American Furnace Co., for electro- ıllurgical work, this being one of the first of its kind to ıstalled for purposes of instruction in the country, and w type of resistance furnace of 25 kilowatts capacity, by the Hoskins Co., for maintaining temperatures up ɔoo° C. With the growth of its work and added equip- t, the laboratory of Applied Electrochemistry has now ıed a very crowded condition, and additional space, as as power, will soon be necessary, if the Laboratory is ontinue to provide adequate facilities for all students ing to elect this work.

hile this laboratory was primarily equipped for giving uction to students making Electrochemistry their spe- y, its facilities are available to properly prepared ɜnts in other Departments, such as those studying ng, Chemistry or Chemical Engineering and Electrical neering. The lecture courses offered are also open to ıate students in these Departments. The instruction ıeoretical Electrochemistry is given by Professor Good- and that in Applied Electrochemistry by Professor

Thompson. Mr. Read, a graduate of the Course, assists in the laboratories.

A number of valuable researches have already been published from the Laboratory Among those completed during the past year, or which are in progress at the present time, the following may be mentioned: the separation of oil from condenser water by means of electrolysis,—the properties of metallic conductors at very high temperatures,—the free energy of formation of carbides,—the electrolysis of solutions containing cuprous salts,—and the electrolytic reduction of aluminum.

CHARLES R. CROSS.

DEPARTMENT OF GEOLOGY.

In the geological studies of the Mining Course, changes involving Mineralogy, Petrology, and Economic Geology were adopted in the spring of 1909. Mineralogy is transferred to the third year, the metallic and useful non-metallic minerals being treated in the first term, and rock minerals in the second. The second-term work leads directly into Petrology, both subjects together occupying four hours a week throughout the term. A new collection of rocks designed for the course in Petrology has been arranged by Dr. Loughlin. The specimens are studied primarily without microscope, with a view to such questions as the average mining engineer would meet in his professional work. All mining students, except those specializing in Metallurgy, are required hereafter to study Petrology as a preparation for Geological Surveying and Economic Geology. The third year course in Economic Geology has been discontinued, while that of the fourth year has been strengthened and is hereafter required of students of both the technical and geological in Mining. The course in Microscopical Petrography is retained for students specializing in Geology.

ofessor Jaggar secured subscriptions from friends of the rtment in January, 1909, whereby he was able to send hundred dollars to Mr. F. A. Perret in Naples, for ific investigation of the Messina earthquake. This sum supplemented by money from the Volcanic Research y of Springfield. Mr. Perret was appointed American lar agent from Naples and he was among the first to the scene of the disaster and aid in the work of rescue. as published a preliminary report on his studies and has d Sicily from time to time through the year in continu- of the work. As he is in close touch with Professor alli at Naples and is continually at work upon problems rning the physics of the active Italian volcanoes, Mr. t has become a valuable associate of this Department. table seismograph of his invention is being constructed ringfield.

rough the continued interest of the trustees of the ine A. R. Whitney Estate, a tentative offer was made to epartment of Geology in the autumn of 1908 to build physical Observatory which should combine seismology some geodetic and magnetic work, Twenty-two hun- dollars was secured from Boston subscribers toward an ne fund for this project. It was at first proposed that bservatory should be in the Blue Hill Reservation, in n. In February Professor Jaggar was granted leave sence for a journey to Hawaii and Japan to study vol- s and earthquake establishments. While he was in Iawaiian Islands a committee of the Chamber of Com- e of Honolulu raised by subscribed pledges an annual for five years, conditional upon the transfer of the pro- l observatory to the island of Hawaii, the Institute to n exclusive control of the work. As Hawaii is a vol- and seismic center of world-wide interest, this proposi- has been hospitably entertained, and it is hoped that a transfer may be completed. While in Japan, Profes- aggar received many courtesies from the officers of the

Universities of Tokyo, Kyoto and Sapporo, and spent some weeks in the study of the work of the Imperial Earthquake Investigation Commission and in a journey to the remarkable active volcano Tarumai in Yezo. He wishes here to record his grateful appreciation of these attentions, and also the gratitude of the Department to the several subscribers of money in Boston and Honolulu, above referred to.

This year a graduate course on the Geology of the Igneous Rocks was given by Professor Daly for the first time. He has nearly completed the report on the Geology of the North American Cordillera at the Forty-ninth Parallel of latitude. Its final preparation for the press awaits two of the topographic sheets which the topographers of the International Boundary Commission are providing for the geological atlas of this survey. During the year Professor Daly has edited a scientific work on Labrador by Dr. W. T. Grenfell and others, and has contributed thereto a chapter on the geology and scenery of the northeast coast.

After a profitable visit to the Yellowstone Park, he spent the summer in a study of the Hawaiian volcanoes; the visit to the Kilauea lava-pit, where he spent nearly four weeks, has convinced him that it is the most favorable place in the world for the establishment of a permanent volcanic observatory. He heartily concurs in Professor Jaggar's view that such an observatory should be established at once. Professor Daly is preparing for publication papers on the origin of the alkaline rocks, and on the chemistry of the average eruptive-rock types.

The rock collection has been enriched by a fine specimen of orbicular gabbro from Dehesa County, California, presented by Mr. R. C. Hillis, of Los Angeles. The mineral collections have been increased by the purchase of two private cabinets of minerals, chiefly ores, offered for sale by the executors of the estates of local collectors. The petrographic collections have also received additions through collection by members of the Department and graduate students.

petrographic microscopes have been added to the
ory equipment. Two of these are of the Bausch and
pattern, and are intended for undergraduate work.
rchase of one of these was made possible through the
ss of the Mining Department. The other two instru-
are of the large Fuess type, fitted with mechanical
so as to make them available for the quantitative
of rocks. These instruments are reserved for the use
ibers of the Department and graduate students, and
resented to the Department through the generosity
. William Barton Rogers.

ng the past summer a most important mineralogical
ry was made in one of the granite quarries of Quincy,
This consisted of a large mass of pegmatite, showing
lerful development of unusual minerals. A careful
of these is being made in the mineralogical laboratory.
sults will throw light on vexed problems of the "Blue
mplex."

summer was spent by Professor Warren in the field,
ig the Blue Hill area. The laboratory study of his
ons is now in progress. On account, however, of the
onsiderable amount of careful chemical analysis re-
probably not less than a year's continuous work
necessary for completion of this investigation.

ie Course in Advanced Petrography, studies have been
on by graduate students on the Hedley mining dis-
British Columbia, and on the igneous rocks of Essex
r, Mass.

Waldemar Lindgren, M.E., Geologist in charge of the
of Mining Geology and Metal Statistics of the United
Geological Survey, has been reappointed Lecturer in
nic Geology for 1909–1910, to direct the advanced
in that subject. Mr. Lindgren began his work
ber 17, on leave of absence from Washington for five
During this time, while residing in Boston, he gave
e of thirty-five lectures and conferences on Economic

Geology, with particular reference to ore deposits. His course places special emphasis on the mining development of the Western states. During the spring and summer, Mr. Lindgren, in the course of his official work for the Geological Survey, has travelled extensively in the Cordilleran districts, and has had opportunity to observe the latest development in the science of ore deposits.

Professor Crosby has been chiefly engaged during the past year in the investigation of the geology of Long Island and the Valley of the Hudson River. This work has been done primarily in his capacity as Consulting Geologist to the Board of Water Supply of the City of New York. Professional economic work has also taken him twice to the Pacific Coast. He spent the month of July with the Sierra Club, in the High Sierra of California, studying the glacial geology and physiography of the region. Other research work in preparation during the year by Professor Crosby includes the geology of the Boston Basin, and the structural and genetic relations of parallel and intersecting joints.

During the past year, the paleontologic and stratigraphic division of the Department of Geology acquired by purchase some preparations of recent marine invertebrates, to show the relation of the soft parts of the animals to the parts preserved as fossils.

The Department acknowledges a gift of tertiary fossils from California by William F. Jones, and some tertiary and mesozoic fossils from Vancouver Island by C. H. Clapp.

There are three graduate students who are taking minor work for the degree of Doctor of Philosophy in paleontology. Professor Shimer is engaged in research work on the Pleistocene problem of Sankoty Head, Nantucket, Mass., and the correlation of the Permo-Carboniferous of Arizona and Utah, also other stratigraphic problems in the same states. He has completed, in collaboration with Professor Grabau of Columbia University, the first volume of a valuable handbook on Index Fossils, after seven years of laborious work on the subject.

Loughlin is preparing a syllabus of questions for the
ıtary courses in Petrology and Building Stones. With
sor Warren he has revised the course in Microscopic
;raphy. During the summer, he extended his studies
ıblication, in Connecticut, Rhode Island and near
ı. These investigations deal with the age relations,
ıre and petrographic character of granites and asso-
rocks. With Professor Crosby, he is collecting mate-
r a handbook on the building stones used in Boston,
general text on the study of building stones.

Loughlin continues to teach elementary geology in
ı University. He has co-operated with Professor
y in some of the latter's New York Water Board stud-
d in several private examinations.

Clapp has, during the past year, completed the minor
ts of his course of study leading to the degree of Doctor
losophy, paleontology and physical chemistry. He is
cting his major work in the petrographic geology of
neous rocks in Essex County, Massachusetts.
ing the past summer, he continued the exploration of
uver Island for the Geological Survey of Canada. In
ıst two seasons an area of about four thousand square
has been explored. This area from a geological view-
was virtually unknown, and a part of the area was
t unexplored.

John A. Allan, Assistant in Geology, is making a study
rocks in the Middlesex Fells. During the summer of
in the employ of the Geological Survey of Canada, he
a detailed examination of the rocks in the southeast-
ɔrtion of Vancouver Island, in the Mt. Sicker district,
reconnaissance survey to the interior of the island.
ɔther graduate students, Messrs. Stuart J. Schofield
Norman L. Bowen, are pursuing advanced studies in
epartment of Geology. There are now three candi-
for the degree of Doctor of Philosophy at work in the
tory of Geological Research. The acquisition of a room

for the use of these men has given great satisfaction. Additional cases have been added to the Geological Library and 10 Engineering B has been remodelled.

T. A. JAGGAR, JR.

DEPARTMENT OF NAVAL ARCHITECTURE.

With the revival of activity in shipbuilding in this country it might be expected that the sizes of classes in the Department of Naval Architecture would increase correspondingly. This is to be desired, for, as in other departments of the Institute, there has been a greater demand for graduates than could be supplied. In general the facilities of the Department are sufficient for any increase that may be anticipated. There are, however, certain needs that have already been presented and which become more pressing. In particular the space assigned to the Department library has become insufficient and even after discarding books of doubtful utility it has become impossible to find room on the shelves for the books already in the library. The policy has been to purchase all books that appear valuable, and to keep up duplicate sets of certain proceedings of societies; this policy has been possible through the liberality of a friend who has also aided the Department in other ways. The library has also benefited from gifts from private libraries. In this connection it may be proper to call attention again to the need for a room for keeping drawings and instruments which we are unable now to guard and care for as we should.

During the past year the work of the Institute for the Navy Department received practical appreciation, through the request of the Acting Engineer-in-Chief that a Course parallel to the Course for Naval Constructors should be offered for Naval Engineers. Such a course was laid out to the satisfaction of the officer named. Afterwards, following an opinion of the Attorney General, and Engineer-in-Chief

ointed who, after reviewing the situation, decided
lish a graduate course for naval engineers at the
ıcademy, it being in his opinion of importance to
ı a close association of such a course with the Navy
ıent.

the inception of the Course for Naval Constructors,
ıve been many applications for foreign students to
ıt or a similar Course at the Institute. Citizens of
ted States who have completed our regular Course
ıl Architecture, or who have the equivalent prepara-
ay take a graduate course in Naval Architecture
ecial attention to warship design and electricity, and
:omplish such a purpose. A few students have taken
ıge of this opportunity, being accommodated in the
ş room provided for the naval officers who are de-
or instruction, and using the confidential informa-
›vided the Institute by the Navy Department. Such
›d is not now available for aliens, and while we have
eign students in the regular Course for Naval Archi-
ve have been unable to provide for applicants to take
:onstruction. It has from the first been considered
le to provide for such students and now it appears
e to do so, which is the more fortunate as there are
ıtudents from a foreign country who desire such in-
›n. It may be interesting to note that two naval
ers from a foreign country have taken instruction
Institute with special attention to marine steam tur-
and that a third officer has joined the Institute this

several years courses of lectures have been given to
ts in Naval Architecture by men eminent in the pro-
., and last spring a course was given by M. Bertin,
Constructor (Retired) of the French Navy. It is
that a course of like importance can be arranged this

of the most important and least known problems in

ship propulsion is the interaction of the propeller and the hull. The propeller from choice and necessity is placed directly astern in the wake of the ship and has a distinct advantage from that location. On the other hand the location of the propeller so near the hull serves as a drag and increases the power beyond what would be required to tow the ship. One of the most approved ways of investigating this matter is by aid of a large model which can be navigated and tested in the open water. Through private generosity the Department is able to undertake such an investigation extending over several years, and it is expected that valuable information will be obtained, and that the work will also serve as a stimulus of interest among the students of the Department. This model can also be used for investigation of problems in steering and manœuvring.

C. H. PEABODY.

DEPARTMENT OF MATHEMATICS.

There have been no very important changes in the work or personnel of the Mathematical Department during the year covered by this report. Professor Woods is spending the present year on leave of absence in Europe, and is now engaged in mathematical work in Paris. The temporary vacancy has been filled by the reappointment of Dr. Nels J. Lennes, who was instructor in the Department in 1907–1908. We are this fall using Woods and Bailey's Course in Mathematics for the first time with third-year students. With increasing experience in the use of the new text as a whole, better adaptation to our needs and conditions naturally result. Among the large number of students entering this fall from other colleges it has been necessary to make special provision for only five who were prepared for second-year mathematics except in the elements of calculus. Men from

lleges who have had differential equations are ex-
ı general to be able to make up by themselves the
ıount of that work now given in our second year.
ttention of the Department has been further occu-
h considerations of the best plan for student con-
or rather of the best means of securing personal
ance with the individual student as early as prac-
ı the term. Sometimes this depends on one or more
conferences, but it must always depend very much
ing the size of our sections relatively small. The
:erm the average size of sections is eighteen in third-
thematics, nineteen in other subjects.

H. W. TYLER.

ARTMENT OF DRAWING AND DESCRIPTIVE GEOMETRY.

hanges in the arrangement of the large drawing-
; Rogers, authorized in the spring, were made dur-
summer. The room is now divided into four class
ınd each is provided with an excellent slate black-
nd the usual equipment for lectures and individual
on.

room is in charge of an instructor. By the old sys-
ıs-room work was taken by groups sometimes con-
ıs many as ninety students each. The size of the
:vented effective teaching from the blackboard. Sev-
.ructors assisted the students individually, but the
ɔrs were without definite authority or responsibil-
e size of the divisions interfered with satisfactory
e as well as with concentration on the part of the

the present arrangement, the work in the drawing-
given to groups including not more than forty men
l some of the groups contain but twenty men. Each

instructor meets the same students throughout the term, and has definite authority and responsibility.

To secure consistent results in teaching, especially in Descriptive Geometry, it is believed that the first presentation of at least portions of the subject should be the same for all members of the class. This need is met by lectures given by Professor Adams in Huntington Hall.

In Mechanical Drawing, and parts of the Descriptive Geometry, lectures are given to the smaller groups by the instructors in charge, and at all times troublesome details can be explained, as appears preferable, either from the blackboard or individually.

The advantages derived from the changes in the method of instruction have already become apparent.

Professor Adams has completed the writing on Warped Surface, and this part of his Descriptive Geometry is now in type. The pressure of class work will prevent the completion of the final drawings, but it is expected that the completed work will be ready for use at the beginning of next year.

There is a portion of the instruction in Freehand Drawing which seems to call for special mention. It is the work of Mr. W. Felton Brown in connection with the restoration of the old frieze in Huntington Hall, which was destroyed some nine years ago when the hall was repainted. Mr. Brown has not attempted the exact duplication of any of the previous work, but has endeavored to keep the spirit of the old decoration. This work has been assigned as a regular part of the instruction in Freehand Drawing to fifth-year students in the Architectural Department. They have been encouraged to make original designs, and have been held responsible for all the work from the preliminary sketch to the completed painting. The paintings were made on canvas stretched on frames, so shaped, that they could be fitted into the wall spaces left between the columns. It was thus comparatively easy to do this work entirely in the

ng-room and have it installed in place in a very short
the general appearance being the same as if they had
ɔainted upon the wall surface.
: first seven panels over the stage (including the seal
: Institute) were put in place on class-day 1907. The
f the materials used in this work was defrayed by con-
ions from the graduating class of 1907. The next
four larger panels were added, completing the frieze
e south wall of Huntington Hall. They were unveiled
ıss-day 1908, the cost of materials in this case being
by the alumni members of the class of 1895. Last
twelve panels were completed and placed on the wall
ıss-day 1909. The cost of materials last year was de-
l by a special appropriation made by the Executive
nittee of the Corporation. Through the able criti-
and instruction of Mr. Brown all these panels have
kept in harmony with the general scheme of decora-
ɔf the hall. During the present year Mr. Brown will
ıbly have the fifth-year students add four more panels,
ı will complete the frieze.
ese decorations, which have been obtained by the
:ute at so little cost, give a notable illustration of the
ical value of the instruction in Freehand Drawing
to the architects. This course of instruction is under
irection of Professor Charles L. Adams. He has always
ably assisted in this work by Mr. Brown, and the par-
ır portion of the instruction to which I have just re-
l has been entirely under Mr. Brown's charge.
e only new appointment in the Department this year
ıt of Mr. Frank M. Gracey, a graduate of the Normal
School in Boston, as instructor in Freehand Drawing
ıe first-year class.

ALFRED E. BURTON.

DEPARTMENT OF MECHANIC ARTS.

The total number of students receiving instruction in the Mechanical Laboratories is two hundred and eighty-three. Some of these attend in more than one class, the numbers attending in the several subjects being as follows:—

Subjects.	*Course.*	*Students.*
Carpentry and Wood Turning	II.	54
Joinery and Pattern Work	VI.	31
Forging	II. and XIII.	65
Metal Turning	VI., VIII., and X.	49
Foundry Work	II. and XIII.	89
Machine Tool Work	II. and XIII.	60
Total in all classes		348
Students attending work in two or more classes and counted more than once		65
Total number of students		283

The total number of students attending last year was two hundred and seventy-one. The number of excuses granted to students, entering from mechanics arts high schools, in Joinery, Wood Turning, and Forging, is still on the increase and the instruction in Wood Working is being rearranged to include as much Pattern Making as possible.

Summer School.—The attendance in the Summer School was forty-eight, an increase of two over last year. The numbers attending the several classes were:—

Wood Work	9
Forging	7
Chipping and Filing	3
Machine Tool Work	29
Total	48

The large attendance in Machine Tool Work continues, due to the desire of many students to anticipate their Mechanic

ts of the senior year to obtain more time for thesis or other
partmental or allied work.

ncreased Space.—A part of the room vacated by the Tech-
ogy Union has been utilized for a Pipe Fitting Labora-
y and for the installation of an equipment of pneumatic
nmers, drills, and riveting tools, transferred from the
partment of Naval Architecture. The Chicago Pneu-
tic Tool Co., the donors of most of the pneumatic tools,
e loaned the Institute a 9″ x 9″ belt-driven air com-
ssor. The entire equipment was used for instruction
ing the latter part of last year and instruction in the use
neumatic tools is now given in connection with the work
Chipping and Filing. It is desired to utilize the greater
of the remaining space for a general lecture room,
re illustrated lectures may be given in direct connec-
with the mechanic arts work. Such lectures would
ribe and illustrate processes and methods of doing work
h cannot be carried out with our limited equipment.

lectric Lighting.—A new electric lighting plant is now
lled to furnish current for lighting and power for the
nasium and the Mechanical Laboratories. A Sturte-
25 K.W. direct connected unit supplies the current
the exhaust steam is used for heating. The new sys-
is very much superior to the old and is very much appre-
d.

uipment.—In addition to the pneumatic tools men-
d above there have been installed in the machine-tool
atory, a scleroscope for determining the relative hard-
of metals, a case of machinist's tools from the Browne
Sharpe Manufacturing Co., and a set of electric pyro-
s is soon expected to arrive for use in connection with
ardening equipment and melting furnaces. A new
engine lathe has replaced one of the old engine lathes.
s hoped to install an automatic screw machine but a
ent reduction in price could not be obtained to enable
rchase to be made within the available appropriation.

In addition to this screw machine, which would permit instruction in the operation of automatic machinery, a small radial drill and an additional milling machine are needed. Six engine lathes and five speed lathes purchased in 1876 should be replaced by new tools.

The equipment in the wood working laboratory remains unchanged, some of this, in use since 1877, should be renewed and a few large lathes and a surface planer should be added. The forging laboratory equipment is nearly worn out. It has been put in good repair and its renewal is not advisable on account of its fixed character unless the laboratory is to remain in its present location for a long time. Only the necessary repairs have been made on the foundry equipment thus far. The question of new equipment and the obtaining of much needed additional room for development is now being considered. It was deemed best not to install a larger cupola furnace in the present contracted space.

Building.—The building is in fair condition. A new skylight has replaced the old leaky one over the cupola room. The floors in the machine and wood turning laboratories are too unsteady for good work and new ones are advisable.

Instructing Staff.—There have been many changes. Mr. Theodore B. Merrick, now over seventy-five years of age, was retired on October 1st, by the Carnegie Foundation, after twenty-five years of successful service as Instructor in Wood Work and Foundry Work. Mr. Albert L. Moulton, Assistant in Wood Work, resigned to accept a position at the Mechanic Arts High School, Boston. Mr. Alfred R. Hunter, Assistant in Chipping and Filing, resigned to accept a promising business opening. Mr. Ernest Curley, Assistant in Machine Tool Work, also resigned. The following new appointments have been made: Mr. Jeremiah F. O'Neil, Instructor in Wood Work; Mr. Arthur B. English, Assistant in Machine Tool Work; and Mr. Samuel W. Rounds, Assistant in Wood Work and Foundry Work.

Mr. O'Neil has been connected with manual training work

last twenty-three years. After graduating from one Boston public grammar schools he took charge of the ɔm of our Mechanical Laboratories, where, during cessful four years' service, he obtained considerable nce in machine work, becoming so attached to the ıat he served his time as a machinist and worked sev- ars as a journeyman. During this period of twelve he employed his evenings in study and attending ɜ schools in drawing and high school subjects. In ɜ accepted a position as Instructor in Manual Training boratory Assistant in Physics at the St. Paul's School cord, N.H., where he remained four years, resigning ıd a year in study at the Institute, where he took ɜd work in mechanic arts, descriptive geometry, and ı. On completion of this course he served two years istant in Wood Work and Foundry Work, resigning ɛpt the position of Sub Master in Manual Training Malden High School, which he has successfully filled the last five years. He has entered into his chosen with enthusiasm and has utilized his summer vaca- n study at summer schools and in obtaining practical ɜnce in pattern and foundry work.

English has served his time as a machinist and has ɪ ten years as a journeyman, most of the time as a die . He comes to us with the purpose of obtaining experi- ı teaching.

Rounds is a graduate of a Roxbury grammar school ıs taken courses in mathematics and drawing in corre- ɜnce schools. He has worked as a journeyman pat- ıaker and has had several years' experience in machine in the foundry, and as draftsman. He is very much ɜted in manual training and comes to us to obtain ɛnce in teaching.

R. H. Smith, Instructor in Machine Tool Work, has ɤeral years been engaged in the preparation of a text- ɔn machine work, prepared for the students in techni-

cal, manual training, and trade schools. It is to be published in three parts, the first two of which are now in press. It is expected that this text-book will be a great help to the students and that it will enable more and better work to be done.

PETER SCHWAMB.

DEPARTMENT OF ENGLISH.

The work of the English Department has been continued during the past year on the lines which have been indicated in former reports. The conference system is made a most important feature of the instruction, and gives most satisfactory results. The co-operation with other Departments goes on, and has been especially improved by the working out of a more careful method of handling the reports of the electrical engineers. In the teaching of First Year English a new feature has been introduced. For the first five weeks the freshmen have been given an introduction to the regular work in composition by being put through a course of reasoning and the simpler logical forms. While no attempt was possible at a course in logic which could even aim at anything like completeness, the students have been shown how to test the validity of their thoughts and conclusions, in order in the first place that they might do more in the way of thinking for themselves, and in the second that they might better estimate the value of the statements and conclusions which they will later use as material for theme-work. A pamphlet prepared in the Department was used as a text-book, and by frequent Department Conferences the instructors have been able to try the experiment with something like unanimity of plan and method. The results, so far as can be decided at once, have been good.

To the instructing staff has been added David Carb, A.B.

ARLO BATES.

RTMENT OF HISTORY AND POLITICAL SCIENCE.

course on the History of European Civilization and
present given to the students of the Department of
ecture in their fourth year will in 1910–11 and there-
ɔe given during the third year, and a new course, in
dentical with that now given to graduate students,
enceforth be given in the fourth year. These two
s will in reality form a single continuous course, in-
l to afford a general survey of the development and
ɔal phases of European civilization and art down to
ɔse of the Italian Renaissance. By the use of a sylla-
ɪntaining extensive summaries it is hoped that it may
ɜsible to maintain the sense of historical continuity
ɛlation while concentrating the lectures and topical
g mainly upon the Classical, the Gothic, and the
ı Renaissance periods. A special collection of several
ɲd photographs and lantern slides of works of sculpt-
ainting, and the industrial arts, has been formed for
ustration of these courses and the very large gen-
ɔllection of slides belonging to the Department of
ecture is also freely drawn upon. In addition to tech-
ourses on the History of Architecture and of Ornament
ɪdents of Course IV. will thus be given a survey of
ief schools and the great masterpieces of European art
l in relation to the historical development and the
ɪl and social conditions which produce them. No
ɜchool of architecture, so far as I am aware, includes
regular course so broad or so thorough an historical

n the general foundation thus established it is hoped
enceforth the graduate courses in history and art of-
o fifth-year students may advantageously be devoted
ɛial topics, to be selected from time to time, such, for
le, as Byzantine history and art; the institutions and

art of Venice; Rome as the centre of European civilization and art at the beginning of the sixteenth century; the civilization and art of the French renaissance; etc. In nearly all of these fields the superb collections of the Boston Museum of Fine Arts and of Fenway Court afford a supply of original illustrative material probably superior to that accessible to students in any other American city.

THIRD YEAR OPTIONS IN GENERAL STUDIES.

The number of students electing these options during the past two years, and for the first term of the current year, is shown by the following figures furnished by the Registrar:—

FIRST TERM.	1907–08.	1908–09.	1909–10.
ECONOMICS.			
Economic History	15	29	37
ENGLISH.			
Advanced English Composition	15	17	16
English Literature of 18th Century	15	6	10
The English Bible	3	10	12
MODERN LANGUAGES.			
French III.A (advanced)	11	7	9
French Colloquium	17	17	8
German III.A (advanced)	16	21	9
German Colloquium	26	16	16
Spanish	14		
HISTORY AND POLITICAL SCIENCE.			
Colonial Systems	7	20	20
International Law	48	87	101
History of Science	43	42	31

SECOND TERM.	1907–08.	1908–09.
ECONOMICS.		
Railroad Economics	13	31
Banking and Finance	75	89
Labor Problems	9	15
Organization of Industry	17	
ENGLISH.		
English Literature of 19th Century	13	11
Argumentation and Debate	14	16
MODERN LANGUAGES.		
French III.A (advanced)	10	11
French Colloquium	16	11
German III.A (advanced)	7	13
German Colloquium	10	18
Spanish	10	
HISTORY AND POLITICAL SCIENCE.		
Municipal Government	50	45
European Civilization and Art	9	19
History of Science	20	15

us individuals are likely to draw varying conclu-
om this table; but it may warrant one suggestion
hich a considerable number of persons are, perhaps,
o agree, and that is the desirability, in a school of
racter of the Massachusetts Institute of Technology,
ɔducing a required course in the history of science.
institution of such high standing in the teaching of
ıd applied science, it seems almost imperative to in-
for all students, the study of the history of science,
r that every graduate should possess an outline knowl-
f the general field itself and also understand the rela-
his own branch of the subject to all science and all
:s.

CHARLES F. A. CURRIER.

DEPARTMENT OF MODERN LANGUAGES.

:e my last report, the requirements in Modern Lan-
s have been further diminished by the dropping of
sh from the Course in Naval Architecture, and of
h or German, at the option of the student, from the
ıes in Mining and Architecture. In only six of the
:en undergraduate Courses are students now required
alify both in Intermediate French and in Intermediate
an. These Courses are Biology, Physics, Chemistry,
ıical Engineering, Geology and Electrochemistry.

e year 1906–1907 was the last in which elementary
:h and elementary German were offered and announced
ıe Programme of the Institute. Since then, however,
:ntary German has been offered each year by vote of
'aculty, and this year Elementary French has been like-
offered.

ıe several courses in modern languages, with the number
udents (including listeners) that attend them, and the
of the sections, are shown by the following table:—

Subject.	*Sections.*	*Students.*	*Average size of Sections.*
Italian	1	8	8
French I.	1	16	16
French II.	10	150	15
French III.A	1	8	8
French III.B	2	25	12.5
French Colloquium	1	12	12
German I.	3	62	20.6
German II.	10	158	15.8
German III.A	1	12	12
German III.B	2	40	20
German Colloquium	1	26	26
Spanish I.	1	14	14
Spanish II.	1	4	4
Spanish III.	1	2	2
	36	537	14.9

Number of students taking French	211
Number of students taking German	298
Number of students taking Spanish	20
Number of students taking Italian	8

The size of the average section a little less than fifteen students) is no smaller than it need be to admit of proper attention to individual students. There are three sections numbering twenty or more students, and there is one numbering twenty-six.

For the assistance and encouragement of backward students, hours of conference have been arranged for French I. and French II., and for German I. and German II.—three for French, and five for German, per week. The attendance at these conferences—which have now been held for several terms experimentally—is satisfactory, and seems to justify their continuation.

Most of the students at the Institute have either passed off Modern Languages at entrance, or met the requirements therein by the end of the first year. A certain portion of them, wishing to have a command of a modern language on graduation, and realizing that they cannot have it unless they in the meantime keep up their practice of the language,

y to do so by taking one of the advanced courses. In
any cases these students have not the time to take a whole
ourse, and apply for admission as partial students or as
steners. It seems that there should be a course especially
esigned to meet their cases. Such a course, to consist of
ie exercise a week—without preparation—is under consid-
ation by the Faculty.

A course of fifteen lectures in French on the subject of
othic Architecture, intended especially for architectural
idents, is given for the first time by an instructor of my
epartment—Mr. Dike. I regard this course as pertain-
g to the Architectural rather than to the Modern Language
epartment.

The amount of summer reading in modern languages that
s been done since such reading was instituted in 1906 is
own by the following table:

	1906.	1907.	1908.	1909
mber of students reporting	348	395	361	354
nber of foreign books read	43	50	60	55
nber to every ten students reporting . . .	1.23	1.27	1.66	1.55

This table shows that, of the books read, from one to two
every ten is a foreign one, and that the proportion has
reased from 1.23 in 1906 to 1.55 in 1909. This showing
he more significant and gratifying when it is considered
t the number of students taking modern languages has
reased during these years from about seven hundred
:906 to about five hundred in 1909, and that the reading
oreign books counts for no more in the credit given the
lent than the same amount of reading in English.

he more pressing needs of the Department were set forth
ny report of last year. One of these—the reduction of
size of the average section to fifteen students—has been
. The others are receiving the attention of a committee
ointed last year by the Faculty to look into the working
ny Department. I would emphasize especially the fol-
ng recommendations:

1. Change of time distribution from three hours of classroom work and six of preparation, to four hours of classroom work and five of preparation, per week.

2. Oral tests at the entrance examinations in modern languages.

Both of these innovations are necessary to secure for the student a working knowledge of the language, or a fair appreciation of its genius and spirit. The second is desirable, moreover, as an encouragement and stimulation to preparatory schools in the preparation of students for the Institute.

JOHN BIGELOW, JR.

The Society of Arts.

Meetings of the Society of Arts have been held twice ıch month during December, January, February and March, ith one meeting in April and one extra meeting in Febru- ry. All of these meetings, with but one exception, have been eld in Huntington Hall and the attendance has been very atifying. With the exception of the meeting on March ;th, when a violent storm prevented a large attendance, vo hundred has been the least number present and at the rgest meeting nearly seven hundred were present.

The topics and speakers were as follows:—

ecember.	"Charles River Basin Improvements." By Messrs Youngman and Miller.
	"Modern Methods of Illumination." By Dr. Louis Bell.
nuary.	"The Corrosion of Iron." By Dr. William H. Walker.
	"The Future of Electricity." By Dr. Steinmetz.
	"The Messina Earthquake." By Dr. Jaggar.
bruary.	"Evolution of Organic." By Dr. Sedgwick.
	"Evolution of Inorganic." By Dr. Lowell.
	"The Gas Engine." By Dr. Charles E. Lucke.
ırch.	"Detection of Salting in Mine Examinations." By Mr. Harrison W. DuBois.
	"The Carnegie Institution of Washington and its Work." By Dr. Woodward.
ril.	"Solar Cyclones and Magnetic Fields." Dr. George E. Hale.

The activities of the Society in the past year have resulted the gain of sixty new members, corresponding to an in- ase of nearly fifteen per cent. in the membership.

The Technology Quarterly having been discontinued with December number, it was necessary for the Society to ke an independent publication of its proceedings. Bul- ns have been published each month from December to

April inclusive. A stenographer has been present at the recent lectures and a good abstract has been obtained in cases where the speaker did not have a manuscript. The cost of the Bulletins has been about $2 per page for issuing 1,000. There has been a demand for extra Bulletins and many complimentary letters in regard to them and to the renewed activity of the Society have been received.

At a recent meeting of the Executive Committee it was voted that the Secretary prepare a card index of all present and past members and this has been undertaken. The list of present members is complete and the list of past members well under way.

The expenses of the Society for the past year are as follows:—

Printing Bulletins and Miscellaneous	$340
Secretary	200
Lectures and entertainment of speakers	150
Postage and mailing Bulletins	160
Clerical work	90
Stationery and Bulletin envelopes	47
Total	$987
There have been received for dues	862
Appropriation	500
	$1,362
	987
Unexpended balance	$375

There are at present three hundred and thirty members, a net increase of about fifteen per cent. over last year. Of the older members many will doubtless be found to be eligible to life membership on completion of the card index, but there appears every reason to believe that the dues for the coming year will amount to nearly $1,000. Half as many new members as were obtained during the past year would offset all transfers to the life membership group.

For the Executive Committee,

EDMUND H. HEWINS, *Chairman.*
WALTER S. LELAND, *Secretary.*

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MASSACHUSETTS
ITUTE OF TECHNOLOGY

TREASURER'S REPORT

R THE YEAR ENDED SEPT. 30, 1909

Treasurer's Report.

rporation of the
Massachusetts Institute of Technology:

the honor to submit herewith statements showing
ıcial condition of the Massachusetts Institute of
›gy as of September 30, 1909, as well as the financial
›ns during the fiscal year ended on that date.
statements are presented in accordance with stand-
ıs devised by The Carnegie Foundation for the Ad-
nt of Teaching, for the purpose of making uniform,
› practicable, the annual financial reports of universi-
eges and technological schools throughout the coun-

exhibits have been prepared by the Institute's audi-
ssrs. Harvey S. Chase & Company, of Boston, who have
d the Institute's accounts for the past year under
ructions of your auditing committee. This firm is
gaged in laying out the standard schedules for the
e Foundation, and for this reason the accounts herein
ed are the first in the country to be published upon the
d forms of the Foundation. Particular attention is
o the balance sheet, Schedule B, in which a complete
nt of the assets and liabilities of the Institute is ex-
This balance sheet is explained briefly in the report
ıccountants, which accompanies this statement.
following gifts and legacies have been received during
r, and call for the sincere thanks of the Institute:—

GIFTS, BEQUESTS, ETC., 1908–1909.

for Current Expenses.

General.

Alumni Fund	$41,147.94

Special.

ıd of the Institute," for Sanitary Research Work	8,000.00
A. Noyes, for the Physico-Chemical Research Department	3,000.00
rles G. Weld, for Naval Architectural Department	1,500.00

W. Hubbard, for Research Work in Applied Chemistry is is the second of three annual payments)		1,000.00
nces		500.00
Astor Cary		500.00
y Club, for the purposes of the General Library		500.00
well, Travelling Scholarship in Architecture		500.00
illiam B. Rogers, for Geological Department		296.83
illiam B. Rogers, for periodicals		225.00
ary Pickering, toward repairs		87.50
right Scientific School, for Applied Chemistry		50.00
for Naval Architectural Department		21.77
Willcutt, for new books for Architectural Department		20.00
Total for current expenses		$57,349.04

w Funds or Increases of Funds.

r Improvement Fund:		
. and Mrs. Henry S. Grew	$5,000.00	
s. E. M. Cary	5,000.00	
s. W. H. Forbes	500.00	
bert Treat Paine	100.00	
llace L. Pierce	100.00	10,700.00
lt Osgood Scholarship Fund		5,000.00
r Technology Union Building:		
riend	$500.00	
T. Bradlee	250.00	
F. Bemis	250.00	
S. du Pont	250.00	
nk L. Locke	250.00	
arles A. Stone	250.00	
S. Webster	250.00	
n R. Freeman	150.00	
W. Rollins, Jr.	150.00	
ward Cunningham	100.00	
arles T. Main	100.00	
lliam L. Putnam	100.00	
n C. Runkle	100.00	
G. Stantial	100.00	
. F. H. Williams	25.00	
lliam R. Greeley	14.00	2,839.00
		$75,888.04
Grinding Co., Grinder for use of Machine Tool Laboratory, ue		400.00
Twist Drill and Machine Co., Gages for Machine Tool boratory, value		330.00
or C. L. Norton, Callender Recorder for the Physical partment, value		215.00
lathe and tools from A. J. Wilkinson & Co., value		200.00
Pneumatic Tool Co., Air Compressor for Mechanic Arts partment, value		191.00
		$77,224.04

contributions of funds for current expenses of the In-
received through the Alumni Income Fund Committee

o be of great assistance. A substantial portion of s has been applied to permanent equipment. This ogether with other outlays and special repairs, is to account for all of these contributions during the ($41,147.94), as follows:—

Technology Union (In excess of direct gifts) . . .	$7,786.94
ases	10,200.00
t in Mechanical Laboratories.	2,200.00
Gymnasium	1,300.00
Mining Machinery	325.00
	$21,880.94
ys and special repairs	10,267.00
	$41,147.94

Walker Memorial Fund now amounts, with accrued to $120,796.97.

ord the fact that losses by fires occurred in the Lowell and in the Cabot house during the year. The first ounted to $3,080, and the second to $1,166. Both were vered by insurance.

Respectfully submitted,

FRANCIS R. HART,

Treasurer.

ER 6, 1909.

REPORT OF THE ACCOUNTANTS.

HARVEY S. CHASE & COMPANY,
Public Accountants and Auditors,
84 State Street, Boston.

NOVEMBER 30, 1909.

FRANCIS R. HART, ESQ.,

Treasurer Massachusetts Institute of Technology.

Dear Sir,—In accordance with your instructions we have prepared statements of the financial transactions of the Institute for the year ended September 30, 1909, and of its financial condition at the close of the fiscal year on that date.

These statements are exhibited upon schedules which follow, as closely as practicable, the forms provided by The Carnegie Foundation for the Advancement of Teaching for uniform financial reports for universities, colleges and technological schools throughout the country. These schedules comprise A, Summary of Income and Expense, showing the deficiency of income for the current year. This schedule is supported by A–1, giving classified details of the sources of income, and by A–2, a classified statement of the current expenses of the year. These schedules do not differ materially from the form in which the Treasurer's transactions of last year were exhibited, following the recommendations which we made at that time.

Schedule B is a Balance Sheet which exhibits the assets and the liabilities of the Institute at the close of the fiscal period. This balance sheet is separated into three parts: First, current assets and current liabilities, with the surplus of available assets; Second, investment assets and the endowments or funds liabilities, with the surplus of investments; Third, the educational plant assets taken at their book values, which, as we explained fully last year, are nominal amounts and do not represent the true values of the lands, buildings and

ɔnt of the Institute. Such true values cannot be set ı the books until an appraisement of the properties is The offsetting account on the liability side represents ı of bequests, gifts and endowments which have been l in the educational plant by the corporation from time . As soon as practicable this total will be analyzed e detailed funds from the beginning will be set up y on the books and reported on the Balance Sheet. le B is supported by subsidiary schedules C, D, E, etc., set forth details of the corresponding items on the Bal-ɔheet.

evident from Schedule B that there was on September 09, a surplus of current assets over current liabilities ıting to $233,833.14. This surplus consists of investments have been made during the past years out of gifts, sts and legacies which have been presented to the Insti- or general purposes and which could have been right- expended in those years for current expenses if the cor- ion had so determined. The corporation has acted rvatively in these matters, however, and considerable ɔns of these funds have been invested in securities or rev- producing real estate and for that reason in spite of the encies of revenue each year for a long series of years in the it now appears that there still remains this surplus of able assets from which similar deficiencies in the future be met. It will be noted that a considerable part of surplus consists of real estate with a book value of $176,- ɜ2. (See balance sheet.) This surplus was disclosed only ı drawing off the Balance Sheet following the rearrange- t of the methods and forms of accounting which has been g on during the past year under our supervision.

his rearrangement brought out the additional fact that e had been included in last year's (1907–08) statement of ɔme some $6,875.00 of interest on securities which prop- belonged in the following year (1908–09). This amount included in the report of 1907–08 because the coupons had n clipped and entered to the credit of the Institute prior

date, October 1st, whereas in previous years they ered as of October 1st, or later. This correction revenue deficiency of last year from $23,131.91, ast year's report, to $30,006.91, while the revenue this year after making allowance for this cor- ars as $29,819.51.

ance with the urgent request of The Carnegie that all educational institutions establish a uni- date for their fiscal year, we suggest that the eriod of the Institute be closed on June 30, 1910. ly quiet time during the summer vacation will lable for closing the accounts and preparing the rt each year. Complications concerning tuition ace will also be eliminated.

ules which follow are blank in some instances for hat it has been found impracticable to complete ement of the Institute's accounting methods dur- year. The work will be concluded this year and of the "Uniform" system should be filled satis- he next report.

Very respectfully,

HARVEY S. CHASE & COMPANY,

Public Accountants and Auditors.

Schedule A.*

SUMMARY OF INCOME AND EXPENSE.

FOR THE YEAR ENDING SEPTEMBER 30, 1909.

the year, Schedule A–1	$545,974.84
r the year, Schedule A–2	575,794.35
of Income	$29,819.51

Schedule A–1.

INCOME.

M STUDENTS.			
fees, for year 1908–9		$325,434.25	
e examination fees forfeited		135.00	
ory materials, supplies, etc.		13,549.66	
lecture notes, etc.		2,076.63	$341,195.54
M ENDOWMENTS.			
nds for general purposes		$34,529.52	
nds for special purposes		50,584.08	
nvestments of gifts, etc., in excess of ds		5,154.20	
		$90,267.80	
ome added to funds . . .	$8,251.86		
nuity to Samuel Dorr . . .	1,000.00		
crued interest	1,057.47	10,309.33	79,958.47
NATION AND STATE.			
grant from State of Massachusetts . .		$25,000.00	
States grant of 1890		13,336.33	
States grant of 1862		5,306.68	
Massachusetts for scholarships		4,000.00	47,643.01
			$468,797.02
Carried forward			

in accordance with the "Uniform" schedules recommended by the Carnegie the Advancement of Teaching.

Brought forward		$468,797.02
S BY INDIVIDUALS FOR CURRENT EXPENSES.		
General Purposes.		
M. I .T. Alumni Fund		41,147.94
Designated Purposes.		
For Sanitary Research Fund	$8,000.00	
Physico-Chemical Research Fund . .	3,000.00	
Naval Architectural Fund	1,521.77	
Applied Chemistry	1,050.00	
Salaries	1,000.00	
Library	725.00	
Travelling Scholarship	500.00	
Geological Department	296.83	
Repair Department	87.50	
Architectural Department	20.00	16,201.10
ME FROM OTHER SOURCES.		
Interest and discount	$2,760.08	
Rents, per Schedule F	10,840.00	
Sales of Electricity	1,613.47	
Applied Chemistry earnings	1,216.40	
Refunds to Physico-Chemical Reseach Fund. .	1,220.00	
Refunds to Rogers Scholarship Fund	722.50	
Letter Box rents	37.00	18,409.45
ME. SOCIETY OF ARTS. Dues		1,419.33
Total Income		$545,974.84

Schedule A–2.

EXPENSE.

ARIES OF TEACHERS.		
Professors	$120,505.06	
Associate professors	44,580.00	
Assistant professors	56,192.54	$221,277.60
Instructors	$70,036.59	
Lecturers	9,720.00	
Librarians	1,750.00	
Assistants	33,316.75	114,823.34
GES ACCESSORY TO TEACHING.		
Clerks	$7,230.38	
Stenographers	4,373.47	11,603.85
		$347,704.79

Carried forward . . . . . .

Brought forward		$347,704.79
RATION AND GENERAL EXPENSES.		
s of officers	$21,833.29	
s of assistants, stenographers, etc.	9,563.06	
g and advertising	10,878.13	
se of books, supplies, etc.	50,817.63	
l Expense	17,676.91	110,769.02
AND MAINTENANCE OF PLANT.		
Gas, and Electricity	$25,476.90	
nicians' wages	6,729.59	
rs' wages	42,589.54	
l repairs	8,413.77	
tment repairs	3,634.38	
wages	2,691.00	
o-Chemical Research repairs	268.61	
-room repairs	140.09	89,943.88
ATE EXPENSE		1,436.53
OM (Technology Union)	$32,342.68	
Less Income	30,762.73	1,579.95
CHARGED OFF, General Investments	$3,059.00	
Rogers Memorial Investments	542.00	3,601.00
E		2,645.68
on Temporary Loans		349.58
URES OF SPECIAL DEPARTMENT FUNDS (other than alaries and wages).		
ry Research Fund	$4,695.31	
ed Chemistry	1,449.68	
co-Chemical Research Fund	1,710.35	
tgen Ray Experiment Fund	76.06	
aret Cheney Reading Room Fund	264.82	
l Architectural (Weld) Fund	1,609.58	
el Cabot Medal Fund	1.30	
r Box Fund	18.00	
elling Scholarship in Architecture	250.00	
tectural Prizes	200.00	
ne Teachers' Fund	1,000.00	
ry Scholarships	1,800.00	
n Fund Scholarships	4,972.12	
	$18,047.22	
amounts paid from previous accumulations of funds' income	2,812.83	15,234.39
OF ARTS. Expenses		2,529.53
l Expenses		$575,794.35

Schedule B.

MASSACHUSETTS INSTITUTE
TREASURER'S BALANCE SHEET.

1.

CURRENT ASSETS.

Cash on hand and in banks, available for general purposes, per Schedule C	$48,422.71
Notes Receivable, per Schedule D	12,920.50
Accounts Receivable, per Schedule E	1,833.47
Rents Receivable, less reserve, per Schedule F	4,500.00
Interest and dividends accrued (not established this year)	
Physico-Chemical Research Fund (excess expenditure)	69.77
Excess of investment assets. (Contra, below)	292,275.75
Total available assets	$360,022.20

2.

INVESTMENT ASSETS.

Securities, per Schedule H	$1,972,673.72
Real Estate, per Schedule I	176,917.39
Funds deposited in Savings Banks	6,397.45
Total investments	$2,155,988.56
Cash: In bank, against minor funds	7,484.31
In bank, against funds' incomes	22,349.50
Total investment assets	$2,185,822.37

3.

EDUCATIONAL PLANT ASSETS.

Lands, Buildings and Equipment. Nominal Values.

Total book value at beginning of year, per Schedule J	$1,683,995.39
Additions during year, per Schedule K	10,625.94
Total book value at end of the year, per Schedule J	$1,694,621.33

WALKER MEMORIAL. ASSETS.

Securities, per Schedule H	$116,173.30
Cash in bank (reserved for investment)	4,623.67
Total assets	$120,796.97

Schedule B.

INOLOGY.

BER 30, 1909.

1.

CURRENT LIABILITIES.

Payable, per Schedule N	$7,962.69
es in advance for year 1909–10	97,063.00
deposits in advance, breakage and supplies	10,530.75
deposits unclaimed, breakage and supplies	1,031.13
examination fees	4,380.00
gy Union receipts in advance	130.74
posits outstanding	1,090.75
Massachusetts. Annual grant, in advance	4,000.00
l current liabilities	$126,189.06
f available assets over current liabilities	*233,833.14*
	$360,022.20

2.

ENDOWMENT FUNDS.

general purposes, per Schedule P	$756,850.21
designated purposes, per Schedule Q	1,106,862.60
l invested funds	$1,863,712.81
sh funds, per Schedule R	7,484.31
ıcome balances, per Schedule R	22,349.50
investment assets, derived from unconditioned gifts bequests invested during past years. Transferred to nt assets. (Contra, above)	292,275.75
	$2,185,822.37

3.

EDUCATIONAL PLANT ENDOWMENTS AND CAPITAL ACCOUNTS.

ent for Electrical Engineering Building	$68,000.00
dowments, funds and capital (not yet analyzed into ific items)	1,626,621.33
	$1,694,621.33

WALKER MEMORIAL FUND.

ıt beginning of year	$116,388.40
ne for year, added to fund	4,408.57
	$120,796.97

Schedule C.

CASH RECEIPTS AND DISBURSEMENTS

FOR THE YEAR.

Total Cash Receipts	$830,312.53
Total Cash Disbursements	830,287.29
Excess of Receipts	$25.24
Cash Balance at beginning of year	82,854.95
Cash Balance at end of year	$82,880.19

CASH BALANCE

AT END OF YEAR.

Cash on Deposit at banks:		
Old Colony Trust Company *	$70,772.27	
National Shawmut Bank, for general purposes,	1,382.97	$72,155.24
Cash at offices:		
For general purposes		10,724.95
Cash Balance, as above		$82,880.19

* For minor funds $7,484.31
For funds' incomes 22,349.50
For Walker Memorial Fund 4,623.67
For general purposes 36,314.79
$70,772.27

Schedule D.

NOTES RECEIVABLE.

Description of Notes and Security therefor, if any.	*Date of note.*	*Date when due.*	*Amount.*	*Rate of Interest.*
dvisory Council	5/28/08	5/28/09	$350.00	6%
hapin mortgage (property in Nahant)	—	—	12,000.00	5%
udent's Note	10/2/93	—	125.00	6%
" "	10/1/94	—	125.00	"
" "	2/1/94	—	75.00	"
" "	2/1/95	—	75.00	"
" "	10/1/94	—	118.00	"
" "	10/2/93	—	52.50	"
Total			$12,920.50	

Schedule E.

ACCOUNTS RECEIVABLE.

[illegible] for Summer School	[illegible]	
[illegible]	[illegible]	[illegible]
[illegible]		
[illegible] Breakage, due from 27 students		[illegible]
		[illegible]

Schedule F.

RENTS RECEIVABLE.

Rents at beginning of year		$14,500.00
During year:		
[illegible] Street Grundmann Studios	$5,000.00	
[illegible]gton Hall	3,500.00	
House	1,000.00	
[illegible]husetts Avenue property	840.00	10,340.00
		$24,840.00
[illegible] of Rents during year		10,340.00
Rents at end of year		$14,500.00
[illegible]rve for doubtful accounts		10,000.00
		$4,500.00

Schedule G.

[illegible]EREST AND DIVIDENDS ACCRUED ON SECURITIES.

and Dividends accrued at beginning of year	
and Dividends earned during year	
al	
and Dividends received during year	
and Dividends accrued at end of year	

mputed this year. Schedule is given in order to make a complete illustration of Carnegie Foundation's forms.)

Schedule H.

SECURITIES: BONDS, STOCKS, AND REAL ESTATE MORTGAGES.

INVESTMENTS, GENERAL.

Bonds.

$26,000.00	Am. Dock & Improvement Co. 5s	due	1921	$26,880.00	
105,000.00	American Tel. & Tel. Co. 4s	"	1929	104,700.00	
25,000.00	Atchison, Top. & St. Fé R.R. 4s	"	1995	25,000.00	
34,000.00	Baltimore & Ohio R.R. 3½s	"	1925	30,090.00	
4,000.00	Bur. & Mo. River (Neb.) R.R. 6s non-exempt	"	1918	4,000.00	
43,000.00	Chesapeake & Ohio R.R. 5s	"	1939	48,585.00	
38,000.00	Chicago, Burl. & Q. R.R. 4s	"	1958	38,096.00	
50,000.00	Chi. Junc. & Union S. Yds. 5s	"	1915	51,110.00	
50,000.00	Chi. Junc. & Union S. Yds. 4s	"	1940	49,250.00	
30,000.00	Chi., Mil. & St. Paul R.R. 7s	"	1910	30,227.00	
100,000.00	Chi. & W. Michigan R.R. 5s	"	1921	101,100.00	
17,000.00	Delaware & Hudson R.R. 4s Ref.,	"	1943	17,330.00	
3,000.00	Illinois Central R.R. 4s	"	1951	3,000.00	
120,000.00	Illinois Steel Co. non-conv. 5s	"	1913	119,586.25	
7,000.00	K. C., Clinton & Spgfld. R.R. 5s	"	1925	6,289.21	
50,000.00	K. C., Ft. Scott & Memphis R.R. 6s,	"	1928	56,426.00	
8,500.00	K. C., Mem. & Birmingham R.R. 4s,	"	1934	8,287.50	
50,000.00	Kansas City Stock Yards 5s	"	1910	50,000.00	
18,000.00	Kentucky Central Ry. Co. 4s	"	1987	17,910.00	
3,000.00	Lake Shore & Mich. Southern 4s	"	1928	3,000.00	
75,000.00	Lake Shore & Mich. Southern deb. 4s,	"	1931	75,000.00	
100,000.00	Long Island R.R. 4s	"	1949	96,137.50	
25,000.00	Mass. Elec. Co. notes 4½s	"	1910	24,500.00	
50,000.00	N. E. Tel. & Tel. Co. 4s	"	1930	50,420.00	
52,000.00	N. Y. C. & H. R. R.R. (L. S.) 3½s	"	1998	46,046.65	
36,000.00	N. Y. C. Equipment 5s	"	1919	34,740.00	
31,000.00	N. Y., N. H. & H. 6s	"	1948	35,484.00	
50,000.00	Northern Pac. Gt. Northern Joint 4s.	"	1921	48,500.00	
50,000.00	Oregon R.R. & Navigation Co. 4s	"	1946	51,080.00	
50,000.00	Oregon Short Line 4s	"	1929	48,500.00	
4,000.00	Ozark Equipment Co. 5s	"	1910	4,000.00	
50,000.00	Rio Grande & Western R.R. 4s	"	1939	49,180.00	
25,000.00	Southern Ry., St. Louis Div. 4s	"	1951	24,875.00	
5,000.00	Terminal Asso. St. Louis 4s	"	1953	5,000.00	
50,000.00	Union Pacific R.R. 4s	"	1947	51,554.00	
25,000.00	Wabash Equipment 4½s	"	1912	24,360.00	
19,000.00	Wabash Equipment 4½s	"	1916	18,259.00	
100,000.00	West End St. Ry. 4s	"	1917	101,470.00	$1,579,973.11

Stocks.

Shares.					
172	Boston & Albany R.R.	par	100	$34,456.50	
1	Boston Ground Rent Trust	"	1000	900.00	
64	Boston Real Estate Trust	"	1000	68,605.64	
80	Chi., Mil. & St. Paul R.R. Pf.	"	100	5,738.00	
2	Dwight Mfg. Co.	"	500	1,600.00	
27	Essex Company	"	50	3,780.00	
31	Great Falls Mfg. Co.	"	100	3,472.00	
56	Hamilton Woolen Co.	"	100	5,390.00	
17	Pepperell Mfg. Co.	"	100	2,789.50	126,731.64
	Carried forward				$1,706,704.75

Brought forward				$1,706,704.75
W. B. ROGERS MEMORIAL FUND.				
Bonds.				
Atchison, Top. & St. Fé R.R. 4s . .	due	1995	$24,470.00	
Baltimore & Ohio R.R. 3½s	"	1925	5,310.00	
Chesapeake & Ohio R.R. 5s . . .	"	1939	7,911.00	
C., Burl. & Quincy 4% Gen'l Mtge.,	"	1958	1,000.00	
Chi. Junc. & Union S. Yds. 5s . . .	"	1915	41,292.00	
Cin., Ind., St. Louis & Chicago R.R. 6s	"	1920	4,000.00	
Detroit, G. Rapids & Western R.R.4s,	"	1946	37,500.00	
Fort St. Union Depot 4½s	"	1941	34,825.00	
Kansas City Belt R.R. 6s	"	1916	27,750.00	
K. C., Ft. Scott & Gulf R.R. 5s . .	"	1911	4,000.00	
N. Y. C. & H. R. R.R. deb. 4s . . .	"	1934	30,225.00	
N. Y. Central Equipment 5s	"	1919	965.00	
Republican Valley R.R. 6s.	"	1919	3,200.00	
Rome, Watertown & Ogdensburg R.R. 5s	"	1922	25,560.00	
Wabash Equipment 4½s	"	1916	961.00	248,969.00
JOY SCHOLARSHIP FUND.				
al Life Insurance Co.				5,000.00
avings Banks			$6,397.49	
SUSAN H. SWETT SCHOLARSHIP FUND.				
al Life Insurance Co.				10,000.00
RICHARD LEE RUSSEL FELLOWSHIP FUND.				
ıveyancers Title Ins. Co. Mort. 4½s . .		1913		2,000.00
Totals, per balance sheet			$6,397.49	$1,972,673.75
WALKER MEMORIAL FUND.				
Am. Tel. & Tel. Co. 4s	due	1929	$30,300.00	
Chicago, Burl. & Quincy R.R. 4s .	"	1958	10,000.00	
N. Y. C. & H. R. R.R. 3½s	"	1998	47,986.35	
Oregon Short Line 5s	"	1946	16,310.00	
St. Louis Iron Mt. 4s	"	1933	4,812.50	
Wabash Equipment 4½s	"	1916	6,764.45	$116,173.30

Schedule I.

TMENTS IN REAL ESTATE OTHER THAN EDUCATIONAL PLANT.

Description of Properties.	*Balance at beginning of year. Cost.*	*Balance at end of year. Cost.*
on St. Land and building, Grundmann lios	$142,762.94	$142,762.94
Mass. Ave., Cambridge, Land and build-	16,154.38	16,154.38
ll Road (Cabot House), Land and buildings, listed last year)		18,000.00
	$158,917.32	$176,917.32

Schedule J.

LANDS, BUILDINGS AND EQUIPMENT.

DUCATIONAL PLANT.*

Land and Buildings, Book Values.

ogers Building	$200,000.00
/alker Building	150,000.00
ngineering Building A, Trinity Place	90,000.00
ngineering Building B, " "	57,857.10
ngineering Building C, " "	47,561.08
enry L. Pierce Building " "	154,297.05
oiler and Power House " "	26,916.74
echnology Union " "	19,460.36
ot Number 1 " "	76,315.69
ot Number 2 " "	137,241.60
ot Number 3 " "	282,286.35
lectrical Eng. Building, Aug. Lowell, Clarendon St.	121,790.93
Iechanic Arts Building, Garrison St.	30,000.00
and, Garrison St.	50,840.00
ymnasium Building	12,624.07
thletic Field, Brookline	112,964.32
	$1,570,155.29

Equipment, Book Values.

1 Engineering Building	16,555.24
1 Electrical Engineering Building	87,282.24
1 Mechanical Laboratories	20,628.56
Total Educational Plant, Book Values	$1,694,621.33

* The values of land, buildings and equipment under this head are nominal values which have been rried on the books at these figures for many years. A complete appraisal of all these properties will soon be ade, and amounts closely in accord with the actual costs, or with the appraised values, will then be entered the books.

Schedule K.

ADDITIONS TO LANDS, BUILDINGS AND EQUIPMENT.

Additions to Lands	$ 0.00
Additions to Buildings, Technology Union	9,000.00
Additions to Equipment, Technology Union	1,625.94
Total during year	$10,625.94

Schedule L.*

RECIATION ON LANDS, BUILDINGS AND EQUIPMENT.

ion written off to beginning of year, viz.:		
Buildings		$
Equipment		
		$
eciation of lands (if any)		
l (net) at beginning of year		$
ion written off during year, viz.:		
Buildings	$	
Equipment		
Total	$	
reciation of Lands		
Depreciation written off		
tion written off to end of year		$

Schedule M.*

NOTES PAYABLE.

	Amount.	
yable:		
porary loans issued	$55,000.00	
porary loans paid	55,000.00	
Total Notes Payable outstanding		$ 0 00
Interest accrued		0.00
Total Notes Payable and Interest accrued thereon		$ 0.00

Schedule N.

ACCOUNTS PAYABLE.

Alumni Association	$632.52
Biddle	580.35
Brookline	554.40
os.	320.02
Mfg. Co.	315.00
Elec. Co.	280.00
ugbee Co.	231.36
h Mfg. Co.	216.28
n Bank Note Co.	184.50
nson & Co.	182.45
lkinson & Co.	162.45
. Swain	153.10
ol Co.	152.80
& Buechner	149.15
eil Chemical Co.	144.10
l. & Tel. Co.	143.60
. Boit & Co.	140.00
Ellis Co.	128.89
nlan	123.56
e Hardware Co.	120.00
& Co.	108.86
n Balance Co.	108.45
ry bills	2,904.26
	$8,036.10
dry debit balances, deducted	73.41
Total per balance sheet	$7,962.69

ded in order to illustrate Carnegie Foundation's "Uniform" schedules.
le O is omitted. This schedule provides for mortgage liabilities of which the Institute

Schedule P.

ENDOWMENT FUNDS FOR GENERAL PURPOSES.

Increases and Decreases of Funds for General Purposes.

Invested Funds.	*Funds Sept. 30, 1908.*	*Income and other increases of funds.*	*Expenditure and other decreases of funds.*	*Funds Sept. 30, 1909.*
Robert Armstrong . . .	$5,000.00	$218.00	$218.00	$5,000.00
Bartlett	10,000.00	436.00	436.00	10,000.00
Blake	5,000.00	218.00	218.00	5,000.00
Choate	25,000.00	1,090.00	1,090.00	25,000.00
B. Dorr	49,573.47	2,161.40	2,161.40	49,573.47
Ann Edwards	30,000.00	1,308.00	1,308.00	30,000.00
und	163,654.21	7,135.32	7,135.32	163,654.21
ne B. Lowell	5,000.00	218.00	218.00	5,000.00
T. Lyman	5,000.00	218.00	218.00	5,000.00
McGregor.	2,500.00	109.00	109.00	2,500.00
el C. Nash	10,000.00	436.00	436.00	10,000.00
Perkins	50,000.00	2,180 00	2,180.00	50,000.00
. and Belinda L. Randall,	83,452.36	3,638.52	3,638.52	83,452.36
E. Rogers	7,680.77	334.88	334.88	7,680.77
Barton Rogers	250,225.00	9,665.56	9,665.56	250,225.00
E. Sawyer	4,764.40	207.72	207.72	4,764.40
iel Thayer	25,000.00	1,090.00	1,090.00	25,000.00
K. P. Welch.	5,000.00	218.00	218.00	5,000.00
G. Weld	15,000.00	654.00	654.00	15,000.00
ler S. Wheeler	5,000.00	218.00	218.00	5,000.00
credited in 1907–08 be-				
ıg to 1908–09	—	2,775.12	2,775.12	
. . . . .	$756,850.21	$34,529.52	$34,529.52	$756,850.21

Schedule Q.

ENDOWMENT FUNDS FOR DESIGNATED PURPOSES.

Increases and Decreases of Funds for Designated Purposes.

Invested Funds.	*Funds Sept. 30, 1908.*	*Income and other increases of funds.*	*Expenditure and other decreases of funds.*	*Funds Sept. 30, 1909.*
FOR SALARIES.				
I. Forbes				
ieneral Salaries	$500.00	$21.80	$21.80	$500.00
A. Gardner				
ieneral Salaries	20,000.00	872.00	872.00	20,000.00
Hayward				
ssorship of Engineering .	18,800.00	819.68	819.68	18,800.00
. Mason				
ssorship of Geology. .	18,800.00	819.68	819.68	18,800.00
3. Rogers				
ral Salaries	25,000.00	1,090.00	1,090.00	25,000.00
iel Thayer				
ssorship of Physics . . .	25,000.00	1,090.00	1,090.00	25,000.00
	$108,100.00	$4,713.16	$4,713.16	$108,100.00

Schedule Q, *Continued.*

DS FOR SCHOLARSHIPS.				
ha Atkins	$5,000.00	$218.00	$200.00	$5,018.00
ngs Student Fund	50,000.00	2,180.00	2,000.00	50,180.00
ius Clapp	5,511.83	218.00	0.00	5,729.83
on Graduate Chemical	5,419.37	218.00	500.00	5,137.37
: W. Danforth	5,666.26	218.00	200.00	5,018.25
White Dickinson	40,841.64	1,769.92	1,600.00	41,011.56
sworth Scholarship	5,000.00	218.00	200.00	5,018.00
les Lewis Flint	5,347.51	218.00	200.00	5,365.51
erry Hunt	3,257.00	130.80	125.00	3,262.80
m F. Huntington	5,285.10	218.00	200.00	5,303.10
cholarship	11,570.47	445.77	400.00	11,616.24
Thatcher Loring	5,450.79	218.00	200.00	5,468.79
H. Mirrlees	2,915.40	109.00	100.00	2,924.40
s Scholarship	5,000.00	218.00	200.00	5,018.00
s C. Nichols	5,441.29	218.00	200.00	5,459.29
elt Osgood	0.00	5,109.00	0.00	5,109.00
d Perkins	53,471.43	2,256.94	2,100.00	53,628.37
l B. Perkins	6,583.25	287.03	0.00	6,870.28
1 Barton Rogers	11,577.32	1,227.27	1,555.00	11,249.59
l Lee Russel	2,339.97	87.20	0.00	2,427.17
altonstall	9,600.00	836.00	400.00	10,036.00
avage	14,617.61	436.00	500.00	14,553.61
Sherwin	5,050.00	218.00	200.00	5,068.00
. Swett	10,595.45	425.00	400.00	10,620.45
pham	1,312.68	43.60	50.00	1,306.28
ite Vose	60,984.61	2,629.66	2,400.00	61,214.27
	$337,838.98	$20,371.19	$13,930.00	$344,280.17
, transfers, &c. incl'd above		6,122.50		
or year for Scholarships		$14,248.69		
OR LIBRARIES AND READING ROOM.				
ewis Flint	$5,000.00	$218.00	$218.00	$5,000.00
Kerr	2,000.00	87.20	87.20	2,000.00
tch Architectural Lib-	5,000.00	218.00	218.00	5,000.00
w Cheney for Mar- eney Reading Room,	14,226.79	610.40	544.82	14,292.37
	$26,226.79	$1,133.60	$1,068.02	$26,292.37
PRIZES.				
ch Prize Fund in re	$5,200.00	$218.00	$200.00	$5,218.00
ch "Special" Prize rchitecture	5,200.00	218.00	0.00	5,418.00
	$10,400.00	$436.00	$200.00	$10,636.00
S.				
n Fund	$360,000.00	$15,696.00	$15,696.00	$360,000.00
n Income Reserve,	12,880.00	1,569.60	0.00	14,449.60
	6,000.00	494.73	325.00	6,169.73
	19,288.48	1,840.98	840.98	20,288.48
Fund	0.00	10,700.00	0.00	10,700.00
ings Richardson hemistry)	37,378.78	1,629.71	1,629.71	37,378.78
rchitectural Fund	25,000.00	1,090.00	1,090.00	25,000.00
Fund	43,097.71	1,879.06	1,409.30	43,567.47
l	100,000.00	4,360.00	4,360.00	100,000.00
	$603,644.97	$39,260.08	$25,350.99	$617,554.06
fers, etc.		13,269.60	21,056.00	
for "other funds"		$25,990.48	$4,294.99	

Schedule Q, *Concluded.*

Recapitulation of Funds.

	At Beginning.	*Income.*	*Outgo.*	*At End.*
CIAL FUNDS.				
ds for Salaries	$108,100.00	$4,713.16	$4,713.16	$108,100.00
ds for Scholarships	337,838.98	14,248.69	13,930.00	344,280.17
ds for Libraries and Reading oom	26,226.79	1,133.60	1,068.02	26,292.37
ds for Prizes	10,400.00	436.00	200.00	10,636.00
er Funds	603,644.97	25,990.48	4,294.99	617,554.06
ome credited in 1907–08 be- nging to 1908–09		4,099.88	4,099.88	
ome from General Invest- ents not credited to Funds		5,116.47	5,116.47	
al Special Funds	$1,086,210.74			$1,106,862.60
ERAL FUNDS.				
Schedule P	756,850.21	34,529.52	34,529.52	756,850.21
AL INCOME per Schedule A-1		$90,267.80	$67,952.04	
AL CAPITAL increases and ecreases		19,392.10	21,056.00	
AND TOTALS	$1,843,060.95	$109,659.90	$89,008.04	$1,863,712.81

Schedule R.

INCREASES AND DECREASES OF MINOR CASH FUNDS.

	Funds Sept. 30, 1908.	*Income and other increases of funds.*	*Expenditure and other decreases of funds.*	*Funds Sept. 30, 1909.*
OR CASH FUNDS.				
lied Chemistry	$0.00	$3,269.65	$3,202.93	$66.72
uel Cabot Medal Fund	100.92	0.00	1.30	99.62
mitory Fund	1,868.96	0.00	0.00	1,868.96
ter Box Fund	61.25	37.00	93.00	5.25
I. T. Alumni Fund	3,811.41	41,147.94	41,147.94	3,811.41
al Architectural Fund (Weld),	87.81	1,521.77	1,609.58	0.00
ntgen Ray Experiment Fund,	956.50	0.00	76.06	880.44
itary Research Fund	705.22	8,000.00	8,703.31	1.91
velling Scholarship in Archi- ecture	0.00	1,000.00	250.00	750.00
	$7,592.07	$54,976.36	$55,084.12	$7,484.31
sico-Chemical Research und	*225.42	7,988.61	7,832.96	*69.77
	$7,366.65	$62,964.97	$62,917.08	$ 7,414.54

* Debit balance.

DS' INCOME.				
h Accumulations:				
dward Austin Fund Income,	$7,890.22	$14,126.40	$16,047.12	$5,969 50
eachers' Fund Income	13,020.00	4,360.00	1,000.00	16,380.00
	$20,910.22	$18,486.40	$17,047.12	$22,349.50

REPORT OF AUDITING COMMITTEE.

BOSTON, Dec. 6, 1909.

the Corporation of the
Massachusetts Institute of Technology:—

Your auditing committee report that Messrs. Harvey S. Chase & Company, blic accountants, employed by this committee, have examined the accounts he Treasurer of the MASSACHUSETTS INSTITUTE OF TECHNOLOGY for the r ended September 30, 1909, and have verified the cash at office and in ks, and their certificate is hereto annexed.
Ve have verified the list of securities held by the Institute.

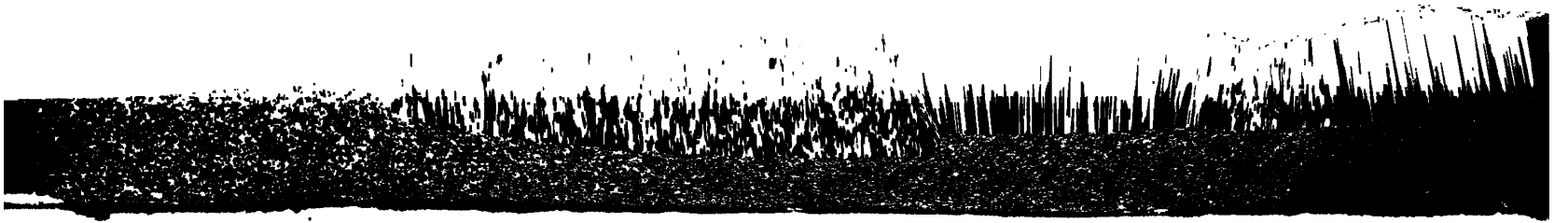
CHARLES C. JACKSON,
JAMES P. TOLMAN,
WILLIAM L. PUTNAM,
} *Auditing Committee.*

AUDITORS' CERTIFICATE.

84 STATE STREET, BOSTON, Dec. 6, 1909.

Auditing Committee of the
Massachusetts Institute of Technology:—

hereby certify that we have examined the books and have audited the ts of the treasurer and of the bursar of the Massachusetts Institute of logy for the fiscal year ended September 30, 1909. We have established ets and liabilities of the Institute as set forth on the balance sheet in- in our report to the treasurer, and have brought the ledger accounts eement therewith. We have found the books in excellent condition, y have been accurately kept during the year. We have verified the s for disbursements, have satisfied ourselves that all receipts of money n acknowledged on the books and deposited in the banks, that the ances of the books on September 30, 1909, were actually available, and e balances were correct. We have verified the details of the book- during the year, have rearranged the methods of accounting in espects and have prepared the report of the treasurer upon schedules l herewith.

Very respectfully,

HARVEY S. CHASE & COMPANY,
Public Accountants and Auditors.